the OIL AND GAS JOURNAL

NOVEMBER 7, 1955

Should the OIL INDUSTRY raise its PRICES ? P. 62

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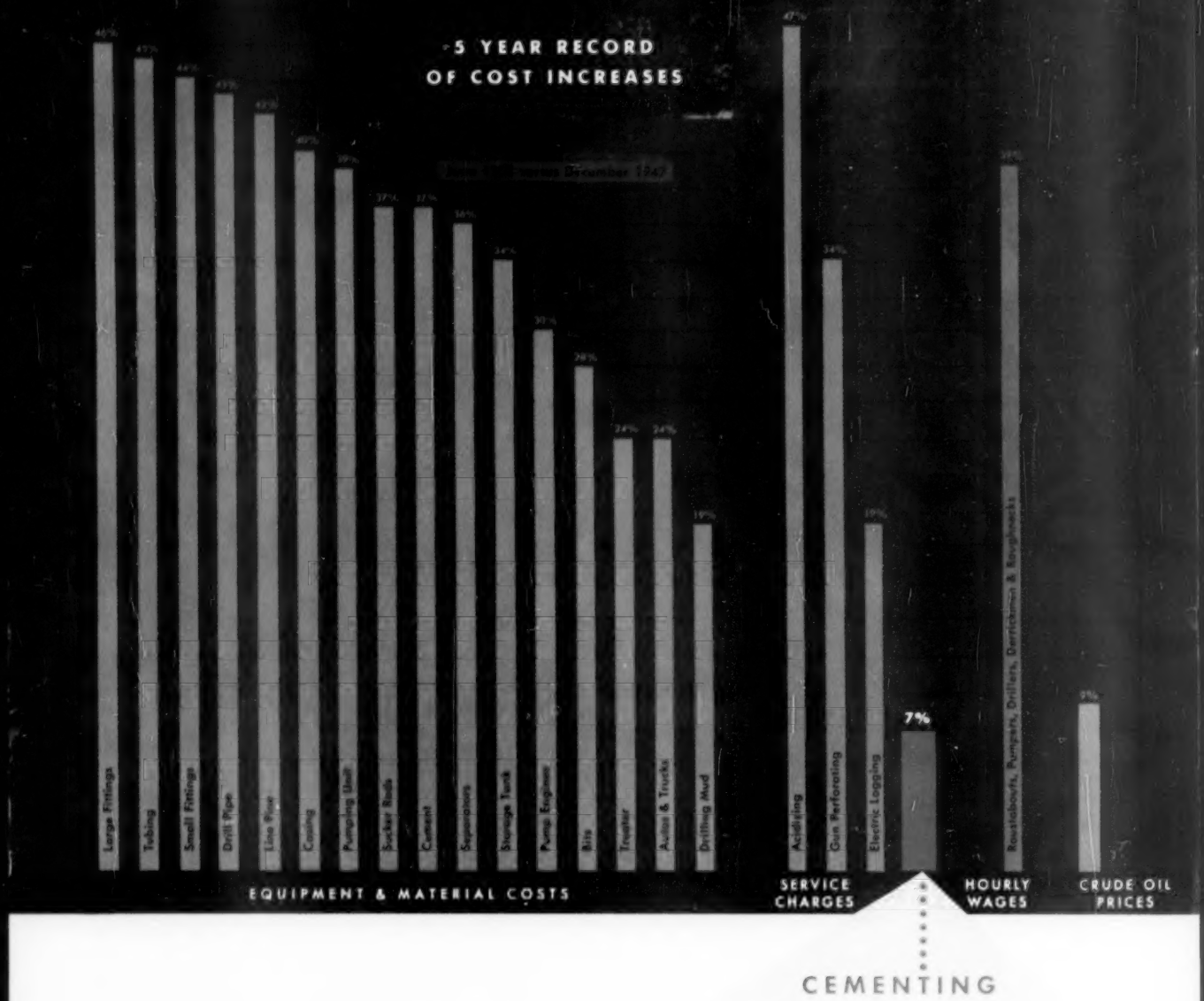

SERVICE *still beyond the fee!*

When first this chart appeared in print, someone else was saying it . . . an independent petroleum association. We reproduce the chart, with emphasis on the low cost of cementing, to illustrate Halliburton's concept of service . . . service above all, service beyond the fee. Last month, an increase in cementing charges went into effect. But it is still the lowest cost service of any on this chart.

"Progress in Service through Research"

HALLIBURTON OIL WELL CEMENTING COMPANY

DUNCAN, OKLAHOMA

A glance ahead . . . at press time

These trends will make TOMORROW'S NEWS

Data-reduction equipment which only weeks ago was only a gleam in the eye of most process people is now being installed in quite a number of refineries and petrochemical plants. And indications are that the trend is snowballing. These installations are justifying themselves in more efficient operation and higher quality product.

A critical shortage of platinum is facing the industry. This metal is used in making catalyst for most of the catalytic reforming processes. At least one oil company is buying its own platinum to furnish its catalyst supplier. This shortage may delay units expected to come on stream in the next few months.

Oil companies which recently bought synthetic-rubber facilities and others are watching closely world requirements for rubber. Commerce Department figures indicate demand for synthetic rubber to increase at the rate of some 4 per cent per year. This compares with estimated increase in natural rubber production of only 1 per cent per year. Better properties, lower price and increased demand all point toward a possible doubling of the present synthetic-rubber capacity by 1960.

Products pipelines are turning to electrical-mechanical schemes to give totalized, corrected readings of positive-displacement meter banks. Idea is to reduce work load on station operators, hence reduce human error factor. Plantation Pipe Line Co. has patents pending on system using differential gearing to inject various correction factors, electrical circuits to add corrected outputs. Operator will have no figuring to do, merely reading on one register-printer the corrected total from as many as eight paralleled meters.

Look for continued increase in unitization activities. Additional water flood projects will require much more joint ventures and merging of leasehold units, before proper coring and injection grid works can be effected. Many of the larger acreage units are already under water flood. This necessitates the unitization of the 10, 20, and 40-acre leases.

There's more progress in in-situ combustion. For this process for secondary oil recovery, recent heat transfer studies show promise. One of the problems holding back this method has been control and maintenance of the combustion front. Recent results show that even if air injection stops during the movement of the front through the formation, a hot zone remains for some time.

This minimizes the problem of reigniting the oil sand when injection is resumed. Don't look for in-situ combustion to recover all of the residual oil, however. Present calculations indicate that about half of the oil remaining after primary depletion must be burned in order to maintain and to propagate the combustion front through the reservoir.

the OIL AND GAS JOURNAL

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OIL AND GAS PIPELINES • REFINING • PETROCHEMICALS
EXPLORATION • DRILLING • PRODUCTION • FIELD PROCESSING

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TECHNOLOGY—OPERATION

Magnolia's Pegasus Gasoline Plant 88

By F. Lawrence Resen

This plant, located near Midland, Tex., is a streamlined natural-gasoline-plant operation. And it is a good example of step-by-step growth, backed by long-range planning. The full-fledged field processing unit began as a simple compressor installation.

U. S. Progress in Drilling with the Turbodrill 93

By W. R. Postelwaite

American designs are now available which make the use of the turbodrill competitive with rotary drilling. Further work is required in developing small-diameter turbines, widening the range of rotational speeds, testing of a rotary speed indicator, and developing improved bearings.

Russian Turbodrill Progress 97

By F. A. Trebin

This is a major drilling method in Russia. By delivering large amounts of power to the bit the turbodrill has achieved drilling rates up to 10 times those claimed to be obtainable by conventional drilling.

Closed-Vapor System Cuts Refinery Vapor Losses 100

By F. Lawrence Resen

Delhi-Taylor has drastically cut vapor losses in its Corpus Christi, Tex., refinery. The system utilizes a vapor tank, equipped with a flexible membrane, which is tied in with all of the light-products storage tanks.

Wash-Oil System Improves Vacuum-Unit Operation 103

A wash-oil system circulates gas-oil over wire mesh screen to prevent plugging and channeling. This improves efficiency and stream factor of the unit.

Audio Signal Announces Interface Arrival 104

By F. Lawrence Resen

An externally mounted radiation device measures specific gravity of an incoming natural gasoline-isobutane stream at Cosden's Big Spring, Tex., refinery. The unit announces the arrival of an interface by means of an alarm system.

Gas-Lifting Both Zones of a Dual Completion 106

By H. W. Winkler

Wire-line-retrievable equipment and other developments have brought about new thinking in gas-lifting in dual completions. This article gives the advantages, disadvantages, and design features of each kind of installation.

How to Empty a Pipeline 116

By S. C. Phelps

When a crude line is taken from service, removal of the line fill presents a tough problem. This article gives current practices in the pipeline industry with good and bad points of each method.

Simultaneous Gas and Water Injection at Poza Rica 120

By John C. Reidel

Bottom-hole pressure in Mexico's big Poza Rica reservoir is being maintained by simultaneous gas and water injection—50,000,000 cu. ft. of gas and 200,000 bbl. of water daily. This article gives the details.

Pipeline Patrol: Batching Gasoline Through Crude Lines 137

By C. N. Adams

Natural gasolines are now being batched successfully through 100 miles of Phillips' crude-pipeline system. This article gives the steps taken to reduce to 3 per cent the volume of contaminated natural gasoline to each batch.

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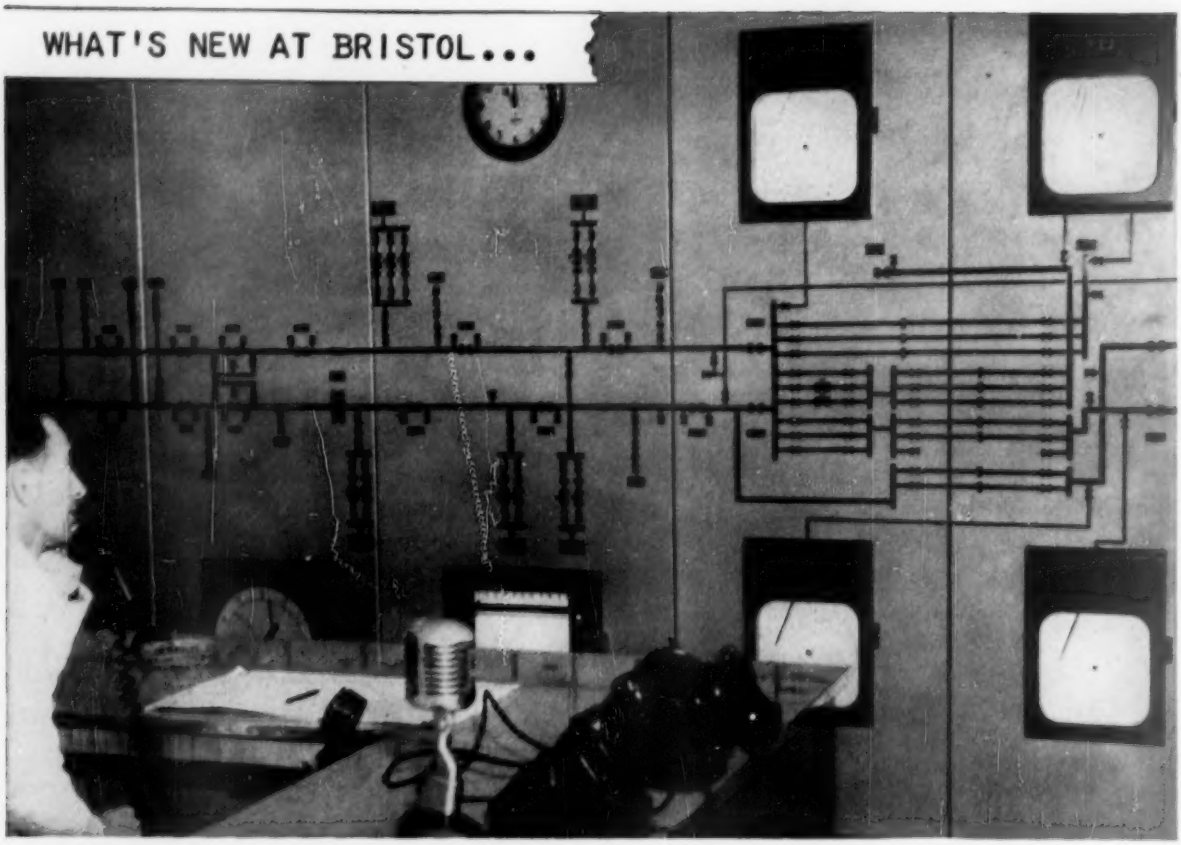
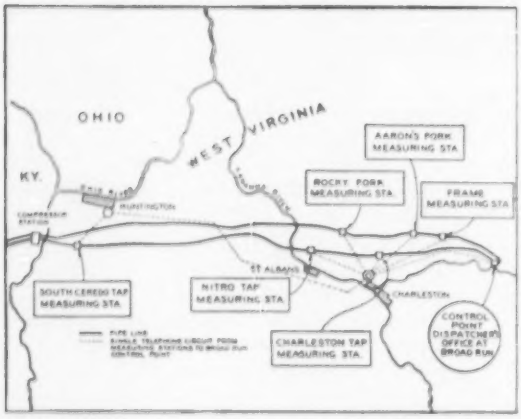
WHAT'S NEW AT BRISTOL...



Now you can dial for pressure readings



MAP SHOWS extent of Tennessee Gas Transmission Company's remote operations — all controlled through a Bristol Metameter Telemetering and Remote Control system over a single 74-mile circuit.

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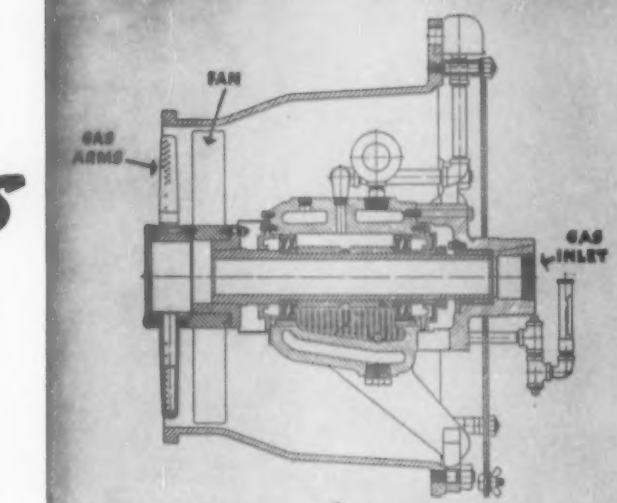

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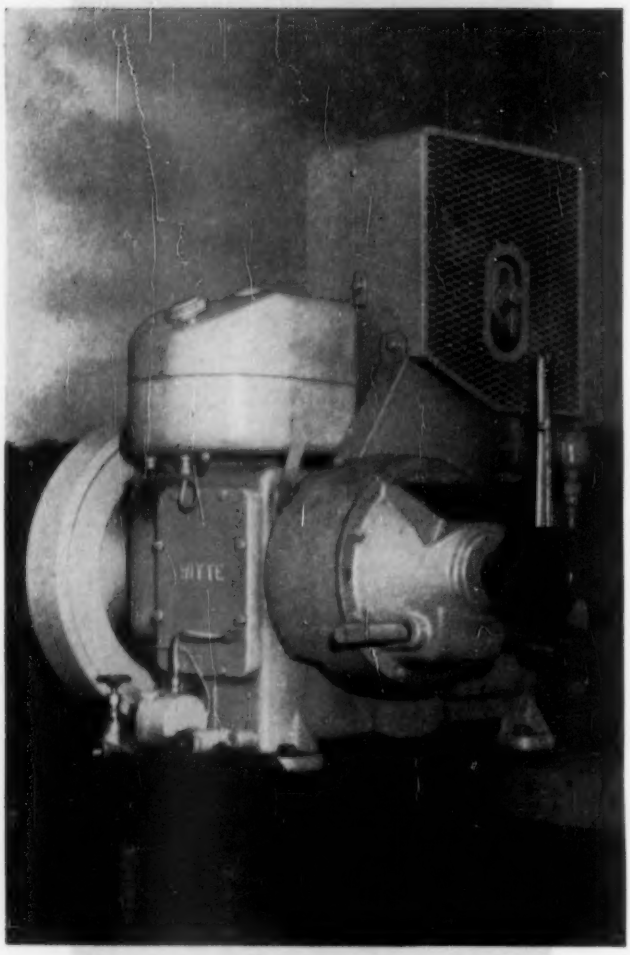

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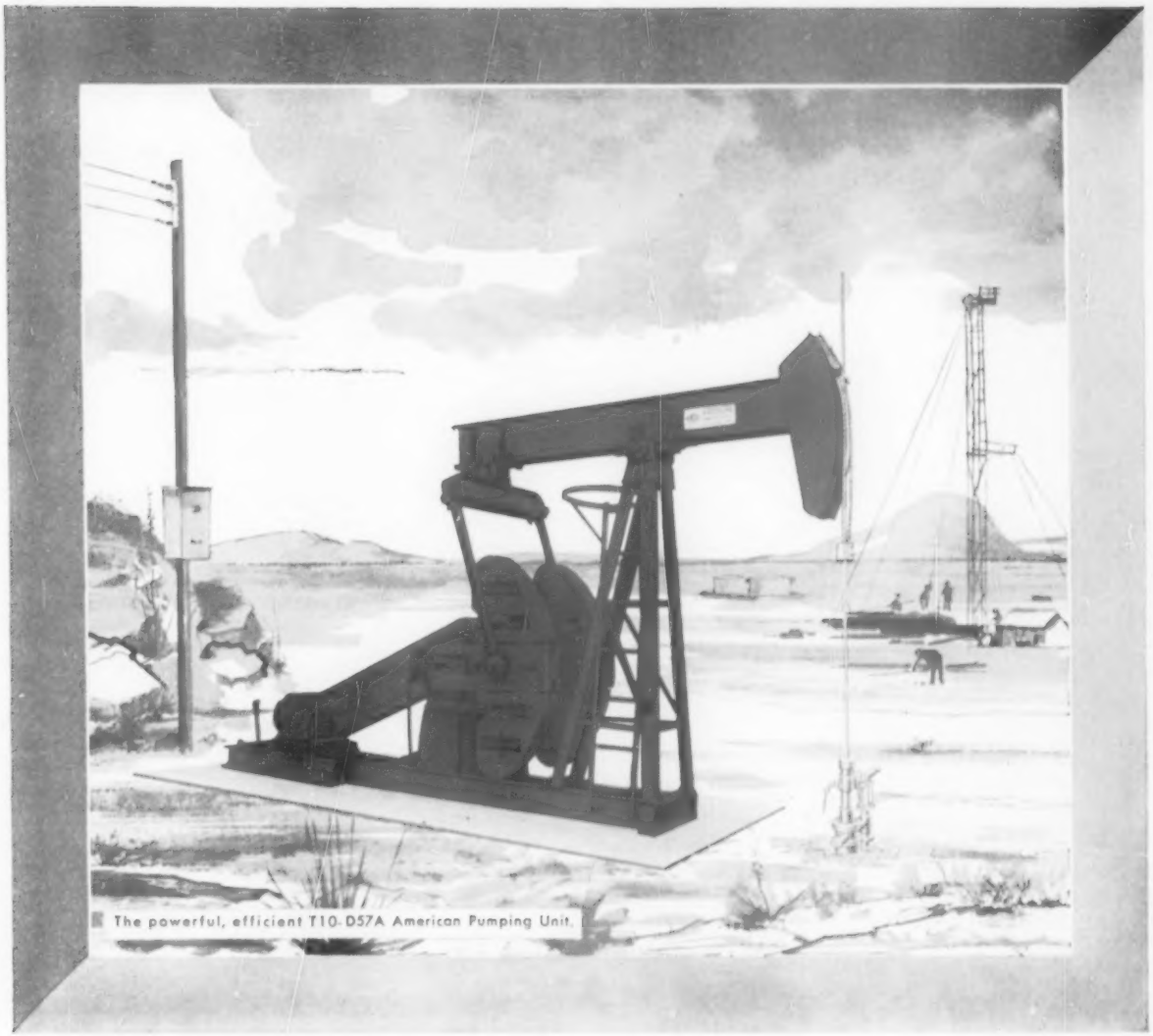

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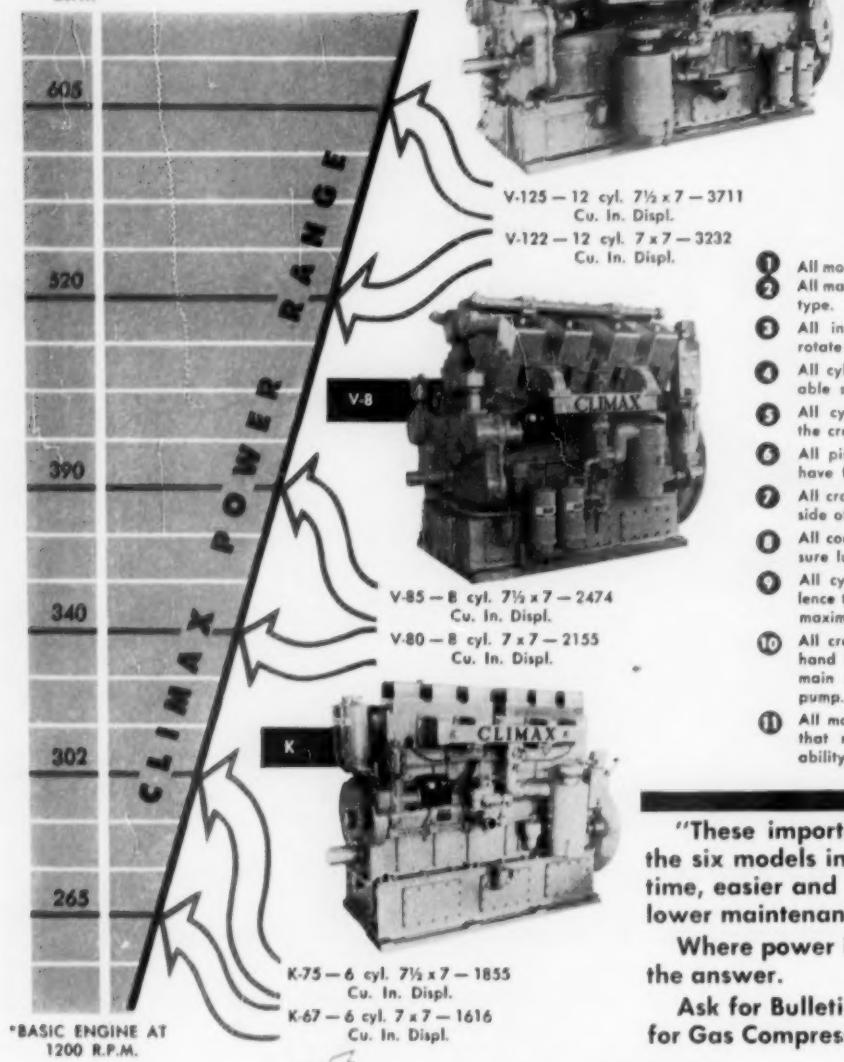
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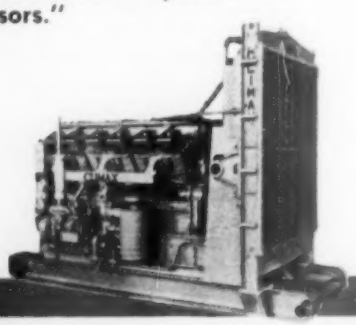

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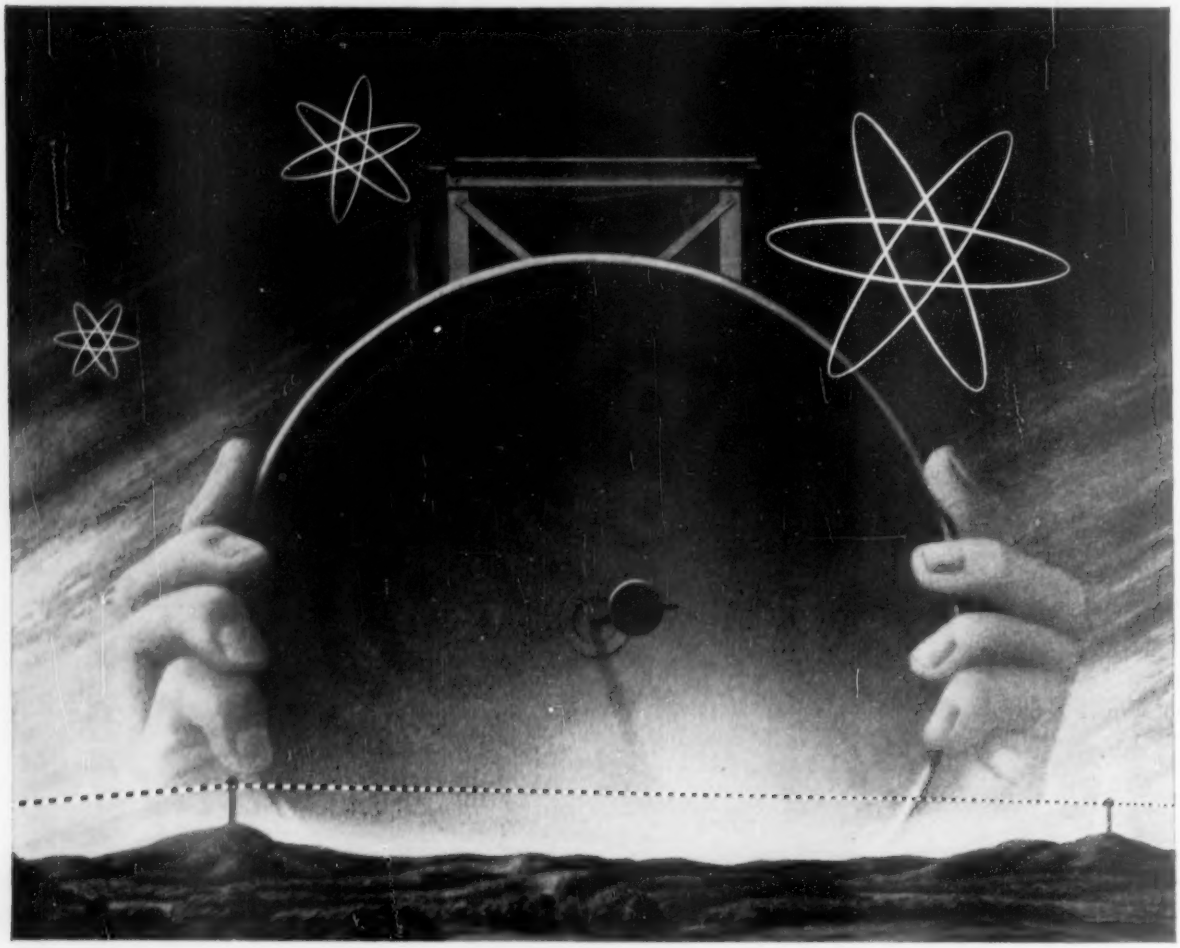

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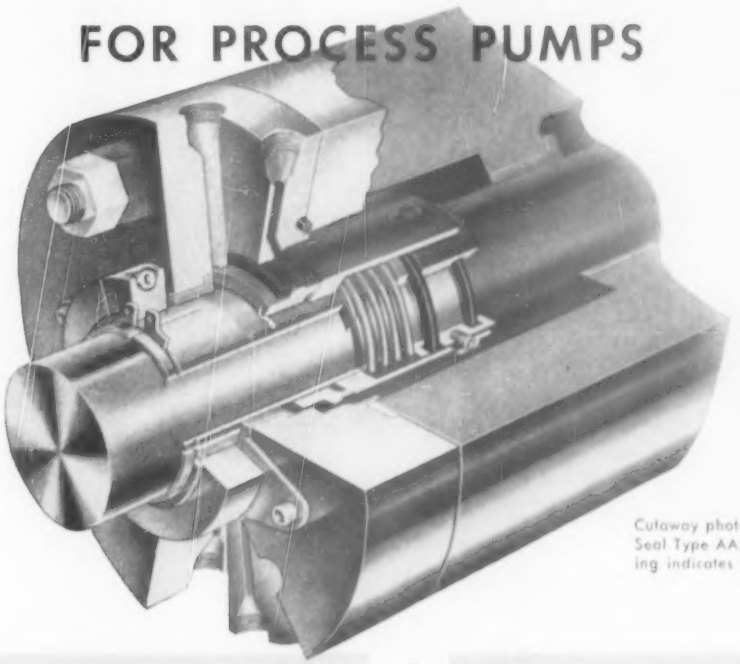
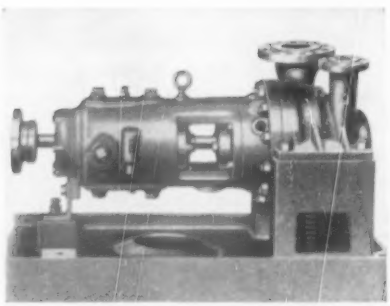


Cutaway photo of Garlock Unitary Seal Type AA51B-23. Yellow shading indicates liquid being sealed.

- One Piece Assembly
- Quick, easy installation
- Pre-set at factory
- Maintenance-free life



Typical refinery process pump for which Garlock Unitary Seals are designed.

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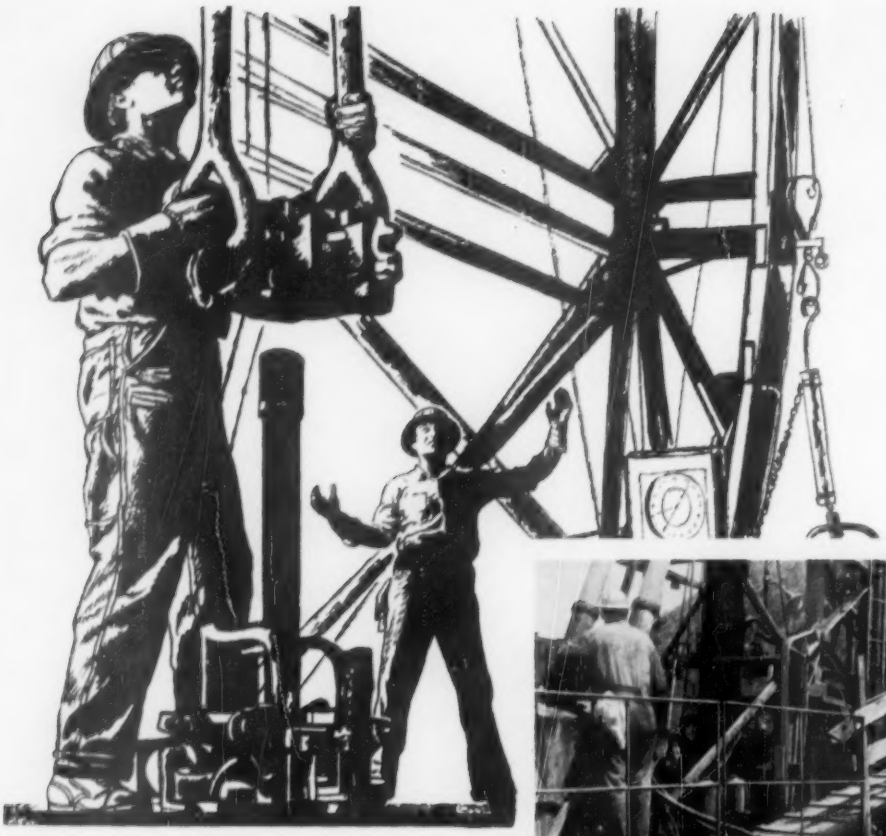

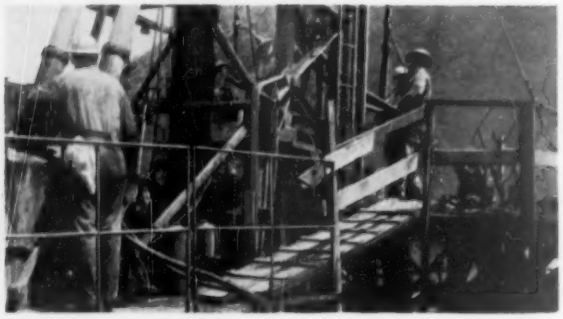

Comes Off Bottom

Smoother than Steam

Saves One Hour Out of Five with TORQMATIC DRIVE

Tide Water Associated Oil Company at Ventura, California, converted one of the firm's well-servicing units from mechanical drive to Allison TORQMATIC DRIVE in April 1952.

The company reports the switch to "smoother than steam" TORQMATIC power transmission increased working speed 20%, made the unit easier to operate. And with the TORQMATIC Converter operators can bring a stand off bottom in low gear using only one of the two engines on the unit.

The unit makes a round trip with a 60-foot stand in 65 seconds, can handle 13,000-foot holes, is easier to operate because there's no manual clutching or de-clutching. And the operator shifts gears at full throttle with finger-tip hydraulic control for faster pipe-pulling

Now Tide Water is converting a second unit from mechanical drive to Allison TORQMATIC DRIVE.

"Smoother than steam" TORQMATIC power transmission speeds drilling, cuts maintenance c[illegible]s and protects drill pipe, well-tubing and sucker rod from shock-load damage. It takes the human element out of oil-field rig operation, cuts costs from well-head to well-bottom.

You can get Allison's matched TORQMATIC Converter-Transmission team — or the TORQMATIC Converter alone, where a transmission is not required—in servicing, drilling and fracturing equipment made by most leading manufacturers. Your engine distributor, equipment manufacturer or dealer can give you full details, or write for more information to Allison Division of General Motors, Box 894R, Indianapolis 6, Indiana.

GM TORQMATIC Allison TORQMATIC DRIVES

NON-SPIN
Can't spin because centrifugal force is neutralized by the offset in the barrel of the gun. Perforated flanges and locking pins permit locking the gun in any desired position.

BOTTOM TYPE
Designed for use where large size metal tanks are employed as mud pits. Simple construction. Easy to install and operate.

SPINNER TYPE
Designed for use where constant agitation is desired. The nozzles are set at an angle and the pressure in the line imparts a spinning motion. This is accommodated by a Style 20 Chiksan High Pressure Swivel Joint. Furnished in any desired length.

Blend it Best—Keep it Right with
CHIKSAN MUD GUNS—

CHIKSAN

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

Insure your drilling operation for complete safety, flexibility and economy by specifying CHIKSAN mud mixing guns. CHIKSAN guns maintain the emulsion in proper solution . . . keep chemical additives and basic weight materials in balance for most effective drilling. A constant suspension of mud, chemicals and water is assured when you use CHIKSAN mud guns.

CHIKSAN COMPANY, Brea, California • Chicago 3, Illinois • Newark 2, New Jersey • Well Equipment Mfg. Corp., (Division) Houston 1, Texas • Chiksan Export Co., Brea, California; Newark 2, New Jersey • Chiksan of Canada, Ltd., Edmonton, Alta

THIS MAN IS MAKING
HIS REPUTATION . . .

DOW

HAVE YOU CHECKED THE SAVINGS YOU MIGHT GET WITH 73%?

The gentleman above has just been struck by an idea. It may very well save his company an appreciable amount of money. The thought: Dow caustic soda in 73% solution is probably *his* best buy, too.

If someone in *your* organization hasn't checked the changed caustic picture lately, you may be missing this chance to save. Hundreds of caustic users *have* discovered the new economy of Dow's 73%. Why an economy? Because today's *increased freight rates* more than cancel out the narrow price difference between 50% and 73%.

A second point of savings, particularly for greater volume users, is the *unloading operation*. Many man-hours are saved because 73% unloads in the same amount of time as a car containing a lower concentration.

A Dow Technical Service man can give you an accurate picture of the savings you could realize with 73%. And don't rule out 73% even if you're now on solid or flake. The pertinent, factual information you get so easily is one of the advantages of dealing with Dow. THE DOW CHEMICAL COMPANY, Midland, Michigan. Dept. AL 392C.

you can depend on DOW CHEMICALS DOW

JET MIX...OR MECHANICAL MIX?

in cementing LITTLE THINGS mean a lot!

THE RIGHT MIXING method can be vital in your cementing job. Long experience has proved to BJ Service, Inc., that no one method is "good for everything." Varying formations and well conditions make important differences in mixing requirements. BJ Service, Inc., offers *both* methods—applies the one mixing method best suited to your well condition. BJ Service, Inc., pioneered important advances in mechanical and jet mixing.

This is just one more illustration of BJ's *job engineered* answers to individual well cementing problems.

On your next cementing job, get the *right* answer, the *engineered* answer. Call your nearby BJ Service office.

OTHER BJ-ENGINEERED OIL FIELD SERVICES:

CALIPER SURVEYS
DOUBLE INTEGRATOR VOLUME COMPUTATION
TEMPERATURE SURVEYS
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PERFORATING . . . JET AND BULLET
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SUBSIDIARY OF BORG-WARNER CORP.

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SERVICE STATIONS THROUGHOUT THE PACIFIC COAST, ROCKY MOUNTAIN AND PERMIAN BASIN AREAS

Engineered ANSWERS TO OIL WELL CEMENTING

2 COMPLETE LINES for Faster, Safer, More Convenient Liquids Handling . . .

SPRING BALANCED • COUNTER BALANCED

OPW LOADING ASSEMBLIES

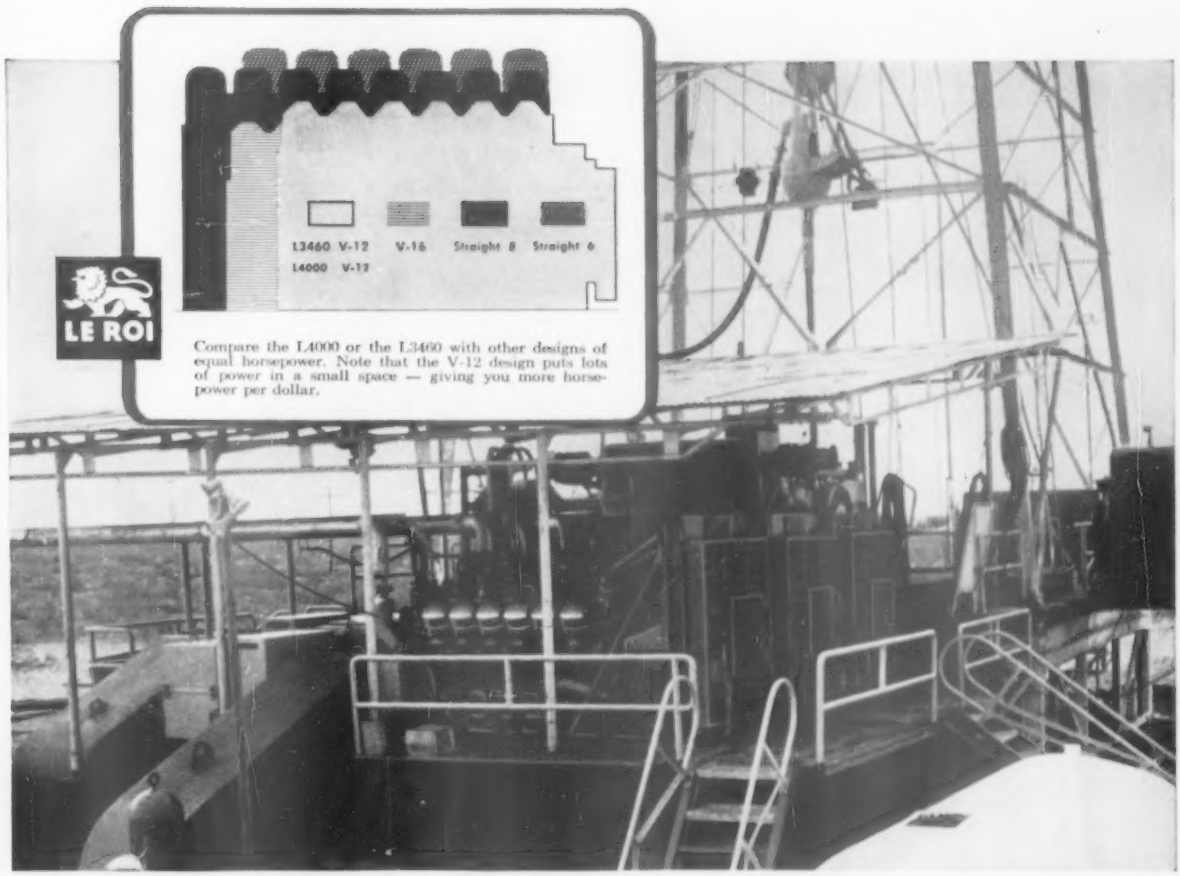
Oil and chemical companies alert to reducing tank car and truck loading and unloading time without jeopardizing safety standards and contaminating product are converting daily to the trouble-free operation of OPW LOADING ASSEMBLIES.

Behind this industry acceptance are several determining factors:

- **COMPACTNESS**
- **CONVENIENCE**
- **FAST DELIVERY**
- **SMOOTH OPERATION**
- **LONG SERVICE LIFE**
- **MINIMUM PRESSURE DROP**

CATALOG F-7 OG provides sizes, engineering data and specifications on all OPW Spring-Balanced and Counter-Balanced Loading Assemblies. Free on request.

OPW CORPORATION 2731 Colerain Ave., Cincinnati 25, Ohio


L3460 V-12
L4000 V-12
V-16
Straight 8
Straight 6
LE ROI
Compare the L4000 or the L3460 with other designs of equal horsepower. Note that the V-12 design puts lots of power in a small space — giving you more horsepower per dollar.

An engine doesn't have to be BIG to be POWERFUL!

The compact, V-12 design of Le Roi's L4000 and L3460 proves it!

Le Roi's L4000 and L3460 engines represent the first truly new design concept in 15 years. They are compact high-output engines, designed with short stroke to give you greater horsepower and speed without compromising engine life.

In addition to the advantages of short-stroke design, these modern V-12's have lightweight pistons, short-radius rotating parts — hydraulic tappets — crankshaft vibration dampener — sensitive controls. That's why they give you hair-trigger response to load demands.

The fuel economy of these engines is good, too. Thanks to advanced-design manifolding, low friction bearings, and low power loss to accessories, they give you rock-bottom fuel consumption.

Yes, big surprises come in small packages. That's especially true of the L4000 and L3460. These engines are conservatively rated to give you plenty of power in reserve. The L4000, for example, provides 655 max. hp. and the L3460, 600 max hp. And they have a wide speed range, too, up to 1350 rpm. That's why these engines are ideally suited to a great many oilfield applications: drilling, pipeline station, generator, gas booster, etc.

Engines may come bigger than these Le Roi's, but they sure don't come better! See for yourself — ask your supply house or Le Roi distributor to show you an L4000 or L3460 at work. Call him soon. Bulletins are also available — just write for them.

LE ROI *Division of Westinghouse Air Brake Co.*

Milwaukee 14, Wisconsin

SOLA-FLEX® AND 76

"Hot" installation for Union Oil Refinery

AT THE WILMINGTON refinery of Union Oil Company, this catalyst expansion joint assembly has a hot job. It must handle both axial and lateral offset movement at a 900 F operating temperature. Solar built four of these units for similar lines in the refinery that manufactures the famous 76 brand gasoline and other petroleum products.

This hot job is a natural for rugged, economical Sola-Flex expansion joints. With standard or special designs for every type of service, Solar can help solve your piping problems involving extreme pressures and temperatures. Write today for a Sola-Flex catalog. Address Solar Aircraft Co., Dept. B-86, San Diego 12, Calif.

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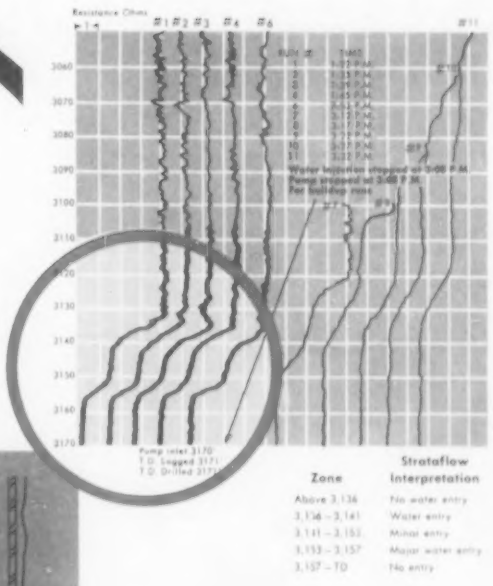
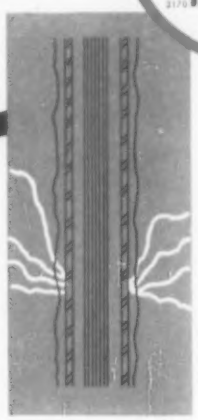
DESIGNERS, DEVELOPERS AND MANUFACTURERS OF METAL ALLOY PRODUCTS · GAS TURBINES · BELLOWS · CONTROLS · HIGH TEMPERATURE COATINGS · AIRCRAFT COMPONENTS

Accurately establishes points of water entry





HALLIBURTON'S STRATAFLOW LOCATES ENTRY ZONES DURING NORMAL PRODUCTION

Accurate information to guide effective workover of water producing wells is obtained by Halliburton's Strataflow Logging System. A complete record is made with the well operating under conditions almost identical to those existing in normal production. Except for temporary shutdown for water consolidation, the well is produced continuously prior to and during the test. Static equilibrium is approached at no time, eliminating the danger of low pressure formations being flooded by foreign waters. A Strataflow survey can usually be conducted in a period of 24 hours with only about eight to ten hours working time involved.

The special 1" Strataflow electrode can be run in the tubing annulus. This electrode measures the varying resistances between conditioning water pumped into the bore and salty formation waters. In wells where no mud anchor is used and where tubing has adequate space for the electrode, there is no need to pull and rerun the tubing and rod strings. Removal of the normal well head seal and lowering of the tubing string to set the pump inlet close to the bottom are the only modifications required.

Solve your water entry location problems fast with the aid of the precise data obtained by Halliburton's Strataflow Logging System. Call your local or district office of the Halliburton Oil Well Cementing Company.

COMPLETE DATA SENT ON REQUEST
Get this valuable information for your Halliburton Service File

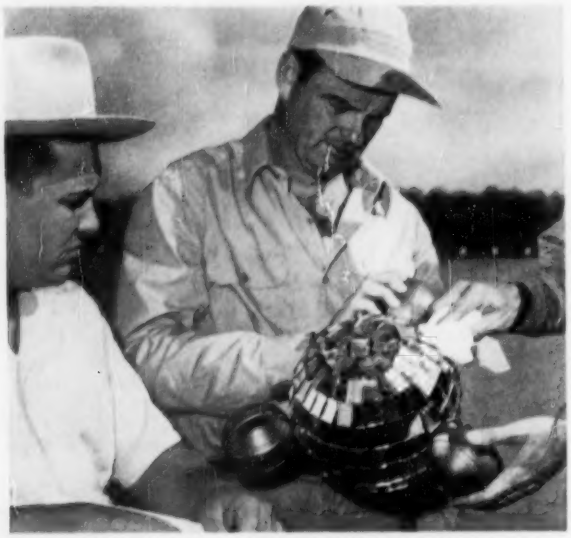
HALLIBURTON
ELECTRICAL WELL SERVICES

Strataflow—Reg. U.S. Pat. Off.

250 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG

SHELL REPORTS

A PICTURE ROUND-UP OF SOME ACTIVITIES THAT MADE NEWS OUTSIDE THE PETROLEUM WORLD



CRYSTAL BALL. To "zero in" on off-shore drill sites with pin-point precision, Shell engineers came up with this spinning, mirrored marker. The "crystal ball" rotates atop a buoy in an off-shore exploration area. Ashore, surveyors on two eighty-foot towers spot the marker by its dancing reflections and "fix" the new drill site. Shell's efficient handling of such everyday problems means faster development of off-shore oil exploration — a vast new reserve for America to count on.

SAFETY IN NUMBERS. Safety at Shell is a full-time job. In this demonstration a .22-caliber bullet is fired into the safety lens of protective goggles. Even with a direct hit, the safety lens will not shatter! Recently, safety-conscious Shell people at the Wilmington-Dominguez Refinery, Calif., amassed a record of almost 4,000,000 man-hours without a lost-time accident. Records like this mean safer working conditions and lower cost, better quality products for everybody.

BUILD A HILL. A boy forever needs a hill to climb — and this designer in Oakland, Calif., is making one. Using a fabric impregnated with Shell's new EPON® resin, a strong, safe "mountain" is formed for active youngsters to climb up and over. This is only one of the many uses found — and yet to be found — for versatile Shell EPON resin. The potential of EPON resin is so great that each week Shell researchers are developing more and more useful and necessary products from it. Shell people work for new methods, new products, and new ideas for easier living.

SHELL

What medium-deep rig provides all-round versatility?

NEW EMSCO A-800

(1000 H.P. RANGE)

gives you packaged portability

...plus flexible power flow

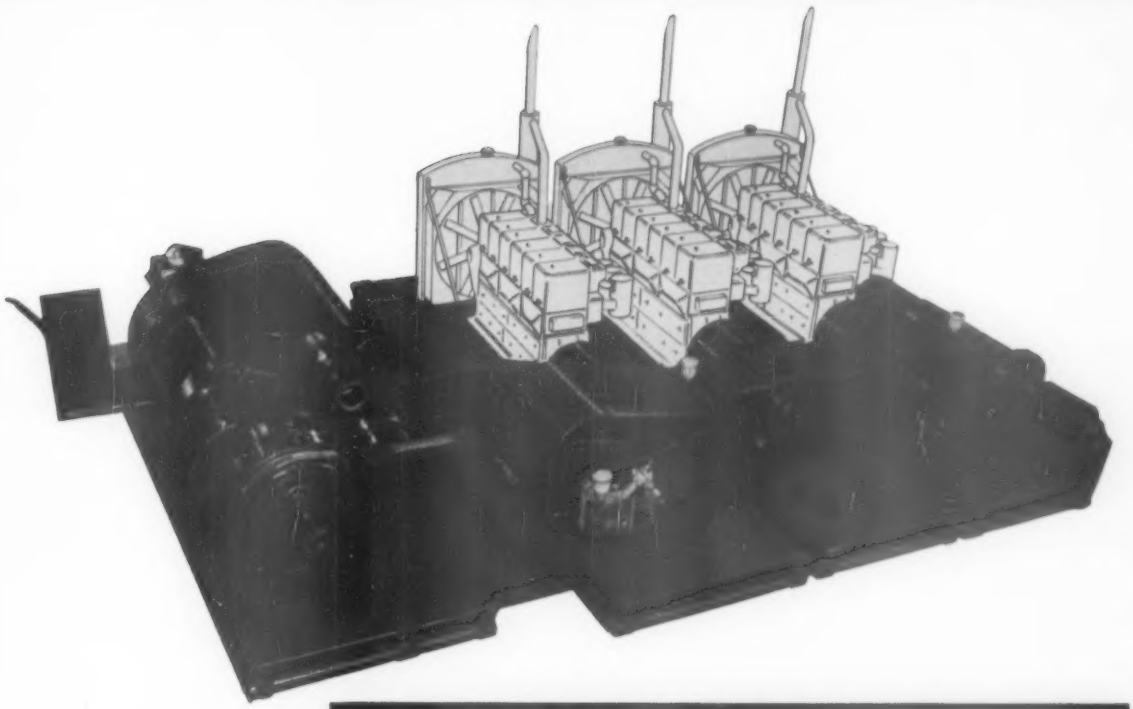
Maximum portability, power flexibility, and economical operation characterize Emsco's new A-800 rig for medium-deep drilling.

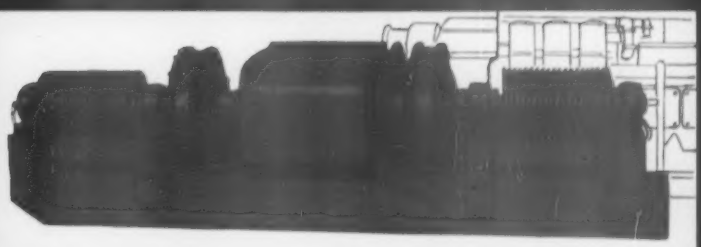
Transportation and rigging-up is simplified. The 3-engine A-800 consists of only 4 packages: drawworks and **3 sectionalized engine units.** Each package is supported on a sturdy skid base and meets existing road width requirements.

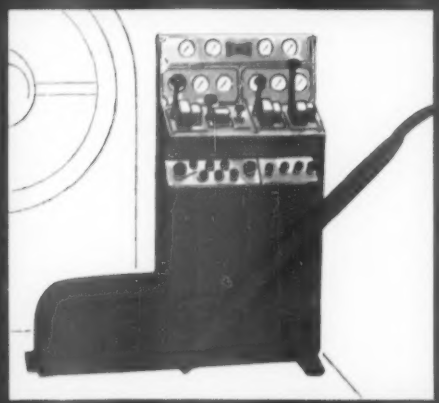
Power flexibility is achieved with a direct air-actuated friction clutch for compounding the No. 1 engine with the other two engines. This compounding clutch, operated from the driller's console, permits separation of the No. 1 engine from the No. 2 and No. 3 engines during drilling operations.

A full pressure lubrication system assures proper lubrication of all working parts at all times . . . thus eliminating costly shut-downs to grease the rig. The drum is large — 24" x 50". A powerful full wrap self-energizing brake provides smooth braking action.

Get the details on this versatile, efficient Emsco A-800 rig. Call your CONTINENTAL representative.







DUAL IN-LINE PUMP DRIVES. Dual pedestal pump drives, mounted in line, simplify slush pump manifolding. Pumps are independently controlled and may be driven simultaneously at different speeds.

FORWARD MOUNTED DRILLER'S CONSOLE. All operating valves and gauges are located in a console, forward mounted for an unobstructed view of floor and derrick operations. Mounted on roller tracks, the console assembly retracts within the drawworks skid to roadable width. It is not necessary to disconnect air or oil lines.

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REG. U.S. PAT. OFF.

EMSCO MANUFACTURING COMPANY
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Serving the Oil and Gas Industries

THE CONTINENTAL SUPPLY COMPANY
General Offices: Dallas, Texas
Representatives in all principal oil fields of the world

E-55

The Payroll AUDITOR . . . . . .

His Job–to Help You Save Money

The TEIA Auditor's job is to help provide the best possible Workmen's Compensation Insurance service and help you SAVE money.

He periodically checks with policyholders to make sure that workers are covered under the proper classifications and that the policyholder is paying no more than he is supposed to pay for his coverage.

Yes, the Payroll Auditor is a part of the TEIA SERVICE TEAM and it's his job to help you SAVE money.

MILLIONS OF DOLLARS
Saved and Returned to
POLICYHOLDERS *by*
TEXAS' *Largest Writer of*
WORKMEN'S COMPENSATION

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NO FUNNEL ACTION

because both acf Regular Round and acf Rectangular Port Valves have port areas at least equal to the pipe itself. Result: no turbulence to flow of viscous ladings and no restrictions to cause abrasion . . . no loss of head pressure . . . all highly desirable features throughout the processing industries.

Other important features are quick, quarter-turn shut off and Teflon* head seal gaskets, resulting in substantially lower maintenance costs.

Representatives in 50 Principal Cities are ready to show you how to keep down valve maintenance costs. Write for Catalog 5, OG-11, Valve Division, acf Industries, Incorporated, 1501 E. Ferry Street, Detroit 11, Michigan.

*DUPONT TRADE NAME

acf CYLINDRICAL FULL PIPE AREA PLUG VALVES

Blanketed Base Pans and Automatic Sentries Push Service Dates Apart

Service dates skip months instead of days where operators have Minneapolis-Moline long-run oil field engines. MM exclusive water-jacket base pan with large built-in filters keep engine and lube oil at constant temperature under any load or weather condition.

Automatic control of crankcase temperature prevents sludging and enables more effective filtering. The high efficiency of MM exclusive vacuum crankcase ventilation is obtained by blanketing the base pan with engine water. This holds crankcase vapor above the dew point so that (instead of condensing and forming sludge) it is withdrawn.

Added advantages of MM long-run design are extra large permanently lubricated bearings, sealed pressure cooling with water by-pass and thermostat control, built-in oil-flow controllers and automatic sentries—safety cutouts that prevent damage in case of low oil pressure or excessive water temperature.

For complete facts and specifications on lowest cost and most dependable power in the oil fields phone

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Twenty Years of Oil Field Engine Application at Your Service

INDUSTRIAL DIVISION

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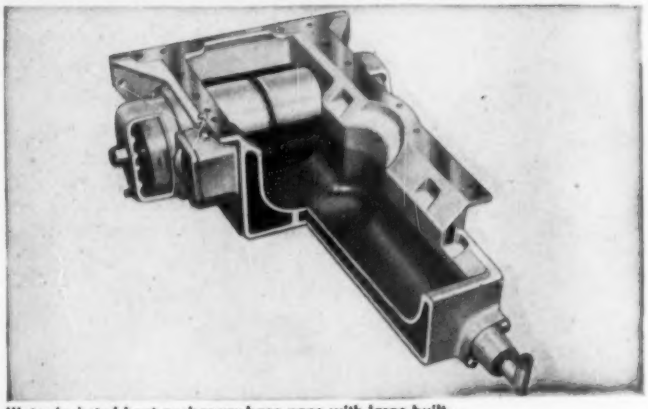
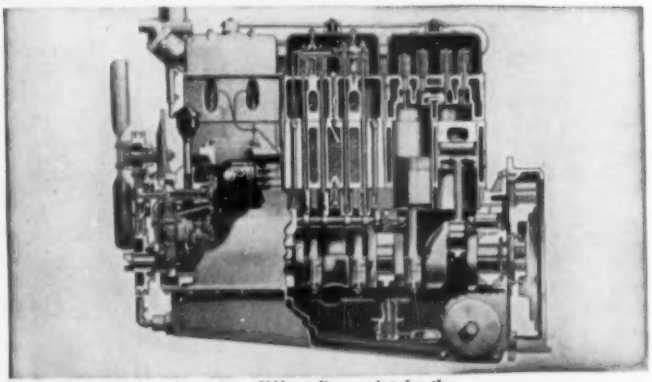


Water-jacketed heat exchanger base pans with large built-in filters provide automatic thermostatic control of lube oil temperature. Oil flow controller maintains constant oil level from reservoir supply. Heavy flange on flywheel end provides 360° rigidity to crankshaft alignment.



Engine cross-section shows how MM cooling maintains the entire engine at a constant temperature. Variation maximum is 4° to 5°. Automatic thermostatic control and by-pass system act as heater or cooler—engine runs at constant temperature under all operating conditions.

. . . he offers you world wide knowledge of water

Under the hat worn by "the man from Layne" is the experience gained in developing water resources of the world for nearly three quarters of a century.

This knowledge is yours without cost or obligation. And experienced men know that on any question from exploration through well drilling to installation, as well as maintenance and modernization, to "ask the man from Layne" is to get unbiased factual information on any phase of water supply for industry, municipalities or agriculture.

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water wells . vertical turbine pumps . water treatment

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VALVES AND FITTINGS

. . . SINCE 1842!

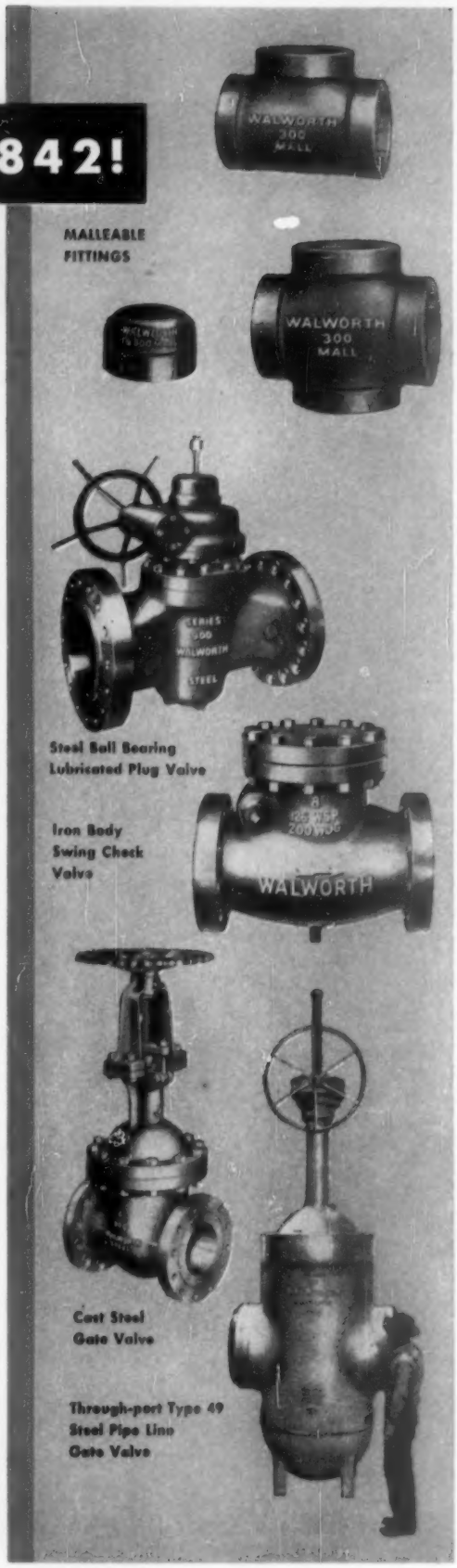
The Amazing Facts About
WALWORTH

The 1840's were eventful years. From Washington to Baltimore Morse sent his first message: "What hath God wrought!" In that decade we found the Antarctic Continent, opened the Naval Academy in Annapolis, declared war on Mexico, sold the first adhesive postage stamps, discovered gold in California. And in 1842 WALWORTH, now the oldest manufacturer of valves and fittings in the United States, set up business in the heart of Boston.

WALWORTH is a bright pattern in the fabric of American industry. To engineers in oil and gas, and to men in these industries who buy for replacement, WALWORTH on valves and fittings is as standard as Sterling on silver.

The amazing range of types, sizes and materials in the WALWORTH line never fails to delight men who know and must depend on valves and fittings in the presence of endless products, pressures, and temperatures. The line is so diversified and so ingenious that many of the machines used to manufacture WALWORTH products must be designed and built by the Walworth Company.

To specify WALWORTH is to tap the mother lode of knowledge and experience in Valves and Fittings.



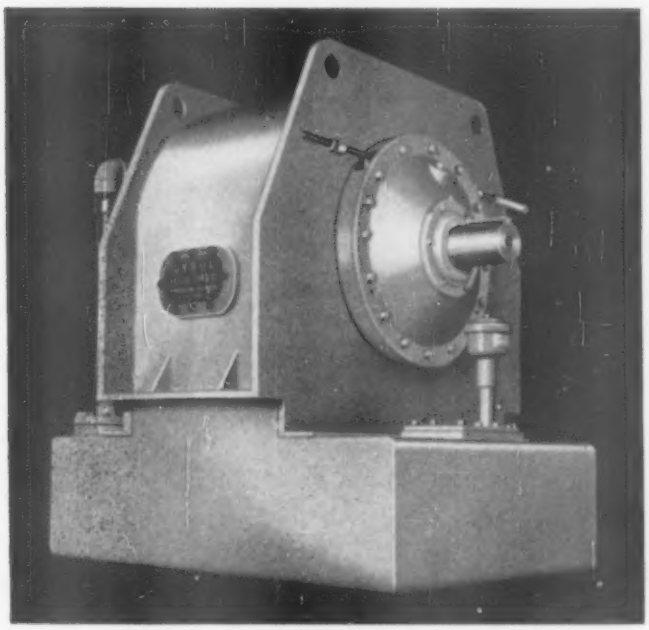
J&L STEEL

Jones & Laughlin
STEEL CORPORATION
SUPPLY DIVISION — TULSA, OKLAHOMA
Serving The United States and Canada

117-G

New American Blower Gýrol Fluid Drive

designed for tough, oil-field application



American Blower's packaged Type VS Class 2F Gýrol Fluid Drive is available from 400 to 1000 hp for operating speeds up to 1200 rpm; fits standard 18-inch-channel oil-fields skids.

The latest American Blower Gýrol Fluid Drive, Type VS Class 2F, is specifically designed for compounding multiple-drive engines on oil-drilling rigs. Because of its excellent cushioning ability, this Gýrol Fluid Drive can be used effectively with any compound design, and provides great flexibility in manipulating pumps.

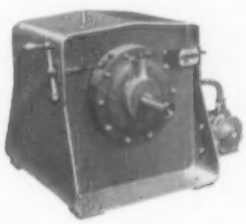
Type VS Class 2F Gýrol Fluid Drive is ruggedly built to meet the long-life service required in rotary, slush-pump, and draw-works operations. It is a self-contained unit — permits infinite adjustment of speed and torque over a wide range.

Under all operating conditions, maximum engine torque can be exerted without danger of stalling the engine — and absolute control of the rate of acceleration produces maximum conservation of engine power.

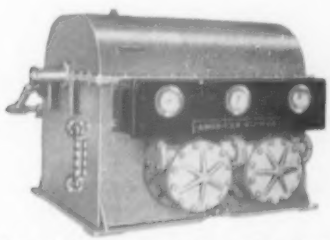
Whatever your application, the new Type VS Gýrol Fluid Drive will provide dependable, long-life service. Call your nearest American Blower Branch Office for complete data.

Traction-type Fluid Drives

American Blower Type TM, traction-type fluid drives are also available as complete packaged units containing AC motor and built-in Gýrol Fluid Drive. Standard NEMA mounting bolt hole dimensions. 1 to 20 hp.



Type VS, Class-2, adjustable-speed Gýrol Fluid Drive. Speed range: 5 to 1. Six sizes, 7½ to 800 hp; speeds to 1800 rpm.



Type VS, Class-6, Gýrol Fluid Drive. Adjustable-speed drive for compressors, pumps, and other high-speed applications. 200 to 12,000 hp, to 3600 rpm.

American Blower products serve the petroleum industry

- Air Conditioning, Heating, Ventilating Equipment
- Mechanical Draft Equipment
- Industrial Fans and Blowers
- Centrifugal Compressors
- Gýrol Fluid Drives

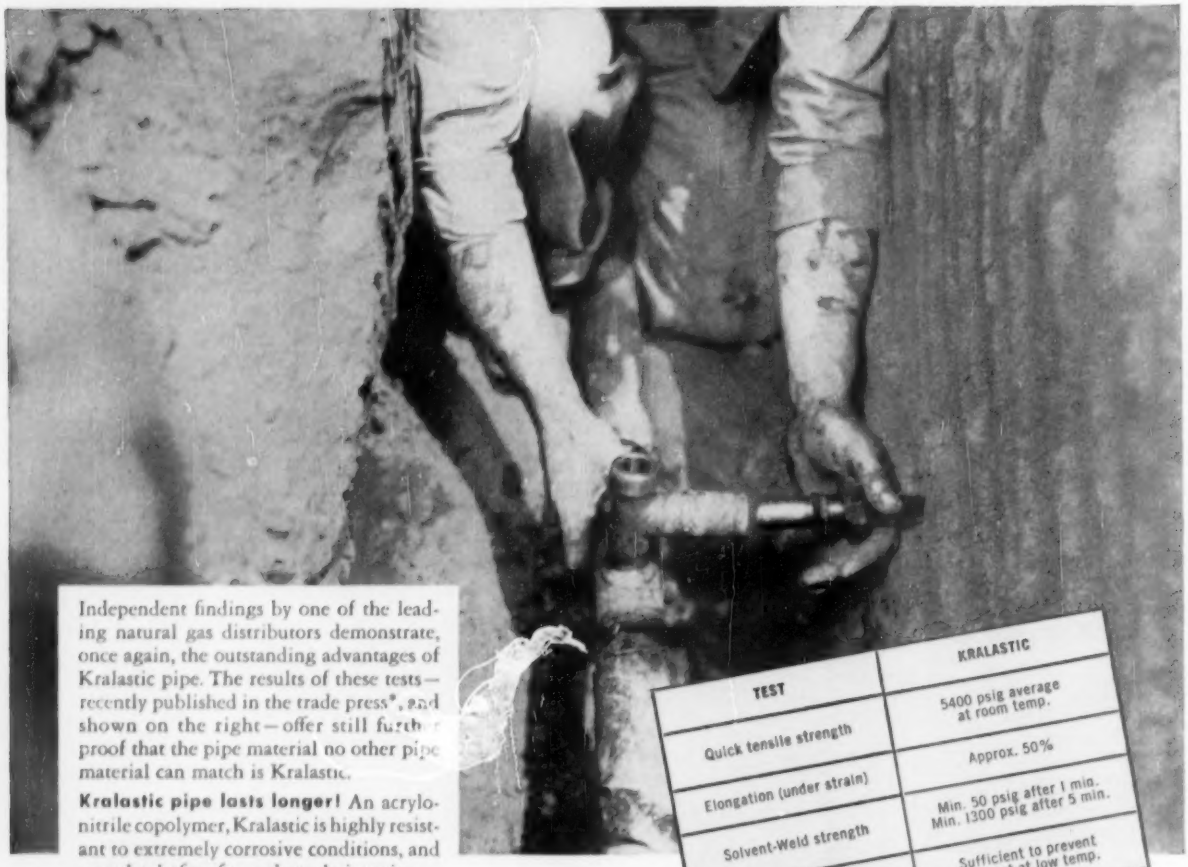
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Gas Company's tests prove

Superiority *of* Kralastic *pipe!*



Independent findings by one of the leading natural gas distributors demonstrate, once again, the outstanding advantages of Kralastic pipe. The results of these tests—recently published in the trade press*, and shown on the right—offer still further proof that the pipe material no other pipe material can match is Kralastic.

Kralastic pipe lasts longer! An acrylonitrile copolymer, Kralastic is highly resistant to extremely corrosive conditions, and completely free from electrolytic action.

Kralastic pipe is easy to handle—easy to install! Kralastic pipe lends itself to snaking through existing lines, eliminating costly, time-consuming labor. Solvent welds can be made and tested in minutes, and because Kralastic is lightweight, one man can carry all that's necessary for the average home service.

Kralastic pipe is easy to maintain—exhibits no scale or interior build-up—is unharmed by alcohol or methanol frequently used to clear freeze-ups.

The first rubber-resin to produce successful plastic pipe, Kralastic has proved its unmatched advantages for carrying natural gas, brine, oil, water, and for many other applications. For additional information on how Kralastic® pipe can economically serve *you*, and for your copy of the test report, write to us, today.

*Gas Age, Oct. 7, 1954—Plastic Pipe Is Gaining Approval.

TEST	KRALASTIC
Quick tensile strength	5400 psig average at room temp.
Elongation (under strain)	Approx. 50%
Solvent-Weld strength	Min. 50 psig after 1 min. Min. 1300 psig after 5 min.
Elasticity	Sufficient to prevent pull-out at low temp.
Effect of alcohols and methanol	Very slight
Accelerated corrosion (buried in moist spent oxide)	No trace
Exposure to weather (after approx. one year)	Tensile = 20% above new Elongation = 20% below new

Naugatuck Chemical

Division of United States Rubber Company

Naugatuck, Connecticut

US RUBBER

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia
IN CANADA: Naugatuck Chemicals, Elmira, Ontario • Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • Cable Address: Rubexport, N.Y.

Complete service at your fingertips

HERE is what Kaiser Steel means to line pipe users in terms of personal service.

It means that you can get immediate, on-the-spot service from our full staff of trained metallurgists, technical men, production men, and sales personnel.

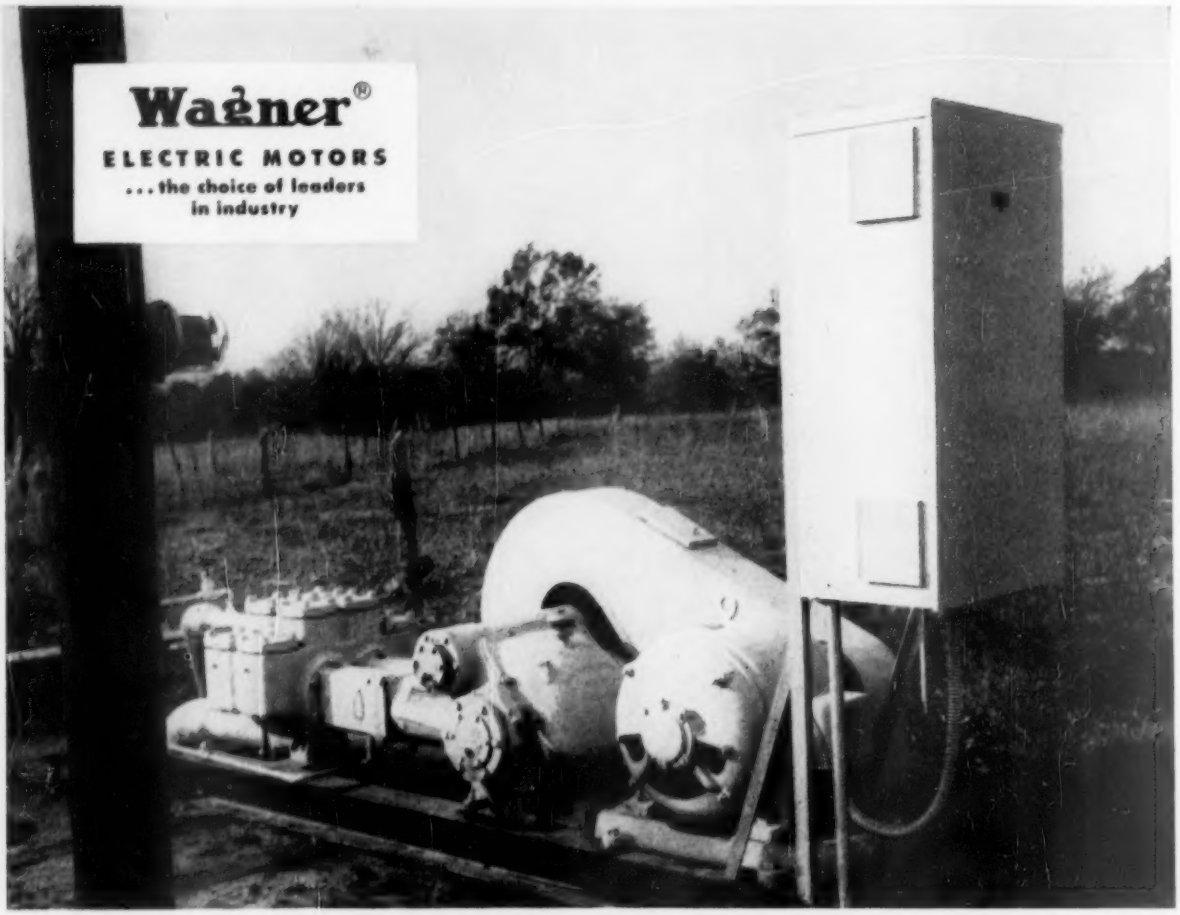
This personal attention to your needs—plus *uniform quality, on-time delivery* and *wide range of sizes*—is another reason why Kaiser Steel can best meet the needs of the area it serves.

Kaiser Steel

KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, California
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, California
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, California
Electric Resistance Weld—Plain End	14" to 20" O.D.	Up to 40'	.250" to .500"	Napa, California
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, California

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Phoenix, Denver, Tulsa, New York



portable power for the petroleum industry

American Oil Pipe Line Company pipes crude oil from lease tanks to storage tanks of oil refineries. The network of pipe in a field is called a "gathering system."

At various gathering system locations, you'll find gathering pumps which keep the heavy crude oil coursing through the pipeline. These gathering pumps are put on skids so they can be moved about to give the system greater flexibility. American can move its pumps quickly and easily whenever new pipe is added or old pipe is abandoned.

A 25 horsepower Wagner motor is the hard-working heart of each of these portable pumps. Wagner motors are chosen for this application because they go about their ceaseless job of hurrying crude oil to the refinery with complete dependability and a minimum of maintenance.

Perhaps you have a specialized motor application . . . if so, remember, there's a Wagner motor to fit every need . . . a complete line for all current specifications with a wide variety of enclosure types and mountings.

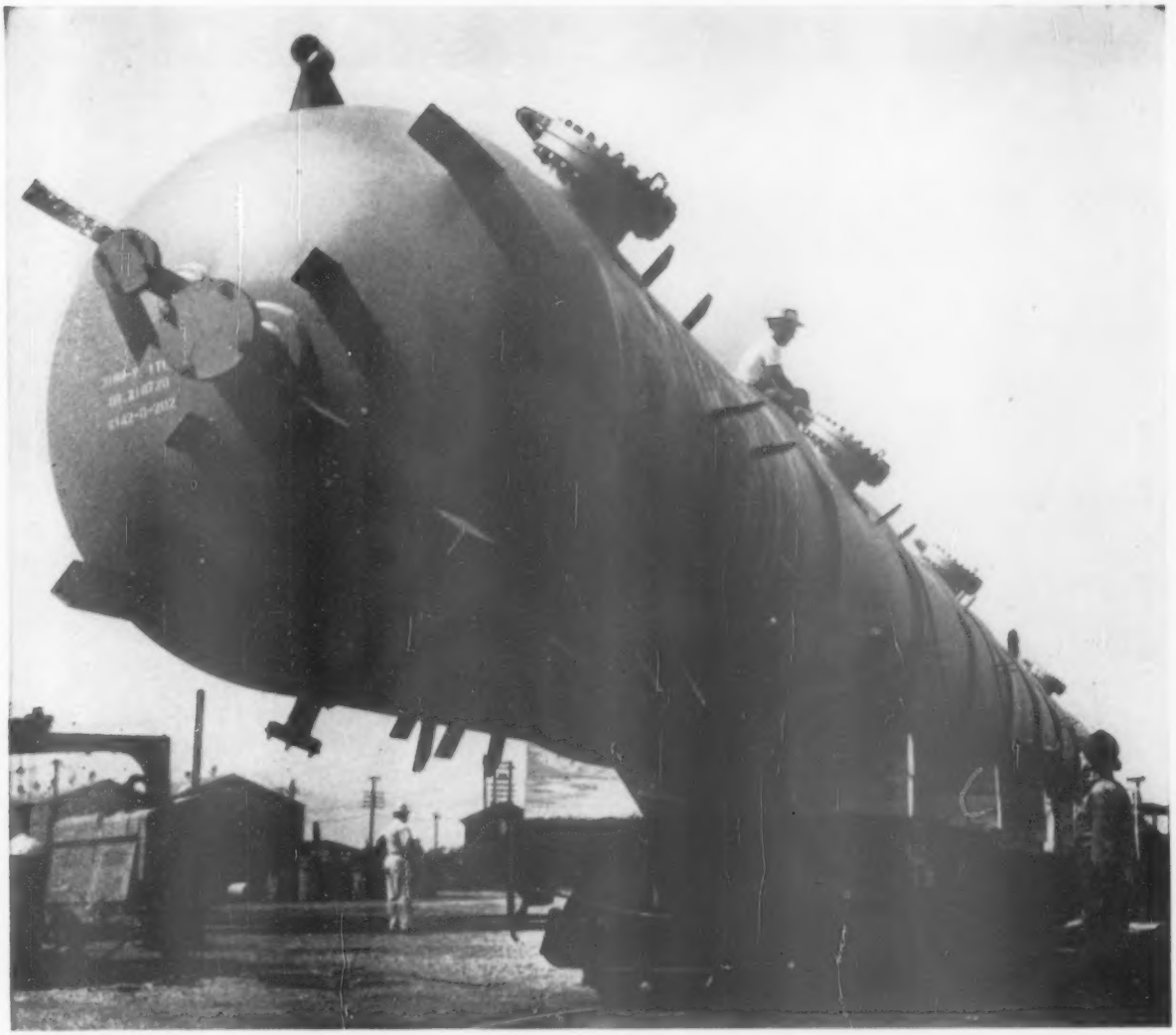
Your nearby Wagner engineer can help you select the *right* motor to meet your specifications. Call the nearest of our 32 branch offices or write us.

Wagner Electric Corporation
6389 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

WM55-B

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS-AIR AND HYDRAULIC



THIS ENTIRE VESSEL was radiographed. Built for use by Socony Mobil Oil Company, Incorporated, it was stress relieved in thirds, and the two joints were stress relieved locally. The unit contains 30 uniflex trays of 96" diameter. Overall weight: 152,000 lbs.

Among the largest in use

...built by Newport News

This Debutanizer with a 110 feet 6 inches over-all length is typical of units that are readily built by Newport News . . .

In fact, Newport News can fabricate almost any type of pressure vessel or other heavy equipment used in the petroleum, chemical or other processing industries.

But at Newport News you'll find more than large productive capacity.

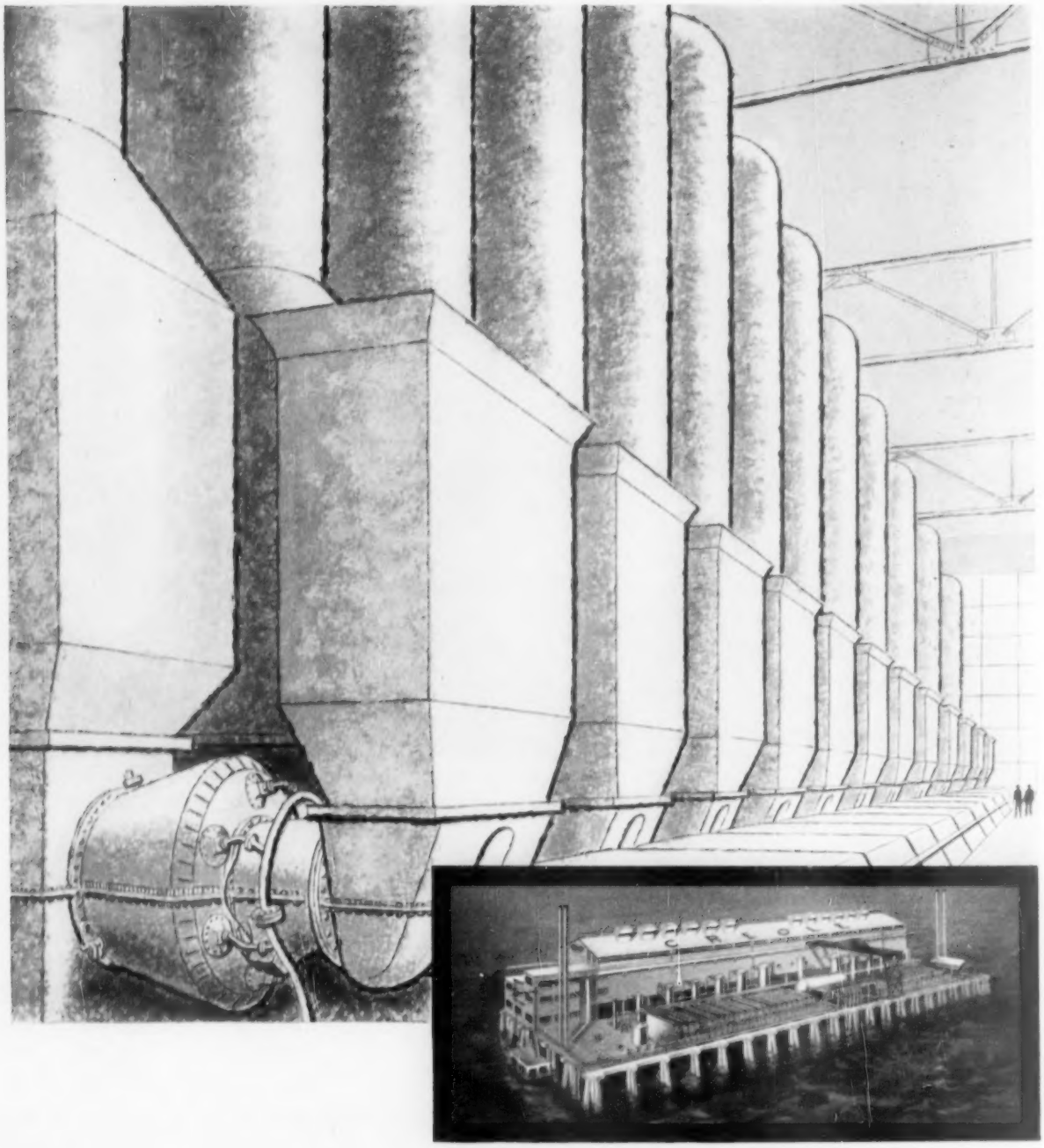
In vast fabricating shops, in huge machine shops, foundries and forging plants, Newport News craftsmen complete your order with specialized techniques. Plant methods . . . developed as a result of specializing for more than half a century . . . enable Newport News to provide money-saving answers to all sorts of heavy equipment problems.

Newport News craftsmen handle the job exactly as you want it done . . . for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and Products"...it's yours for the asking.

Engineers—Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

Newport News Shipbuilding and Dry Dock Company
Newport News, Virginia

NEW GAS TURBINES



GAS TURBINES GO TO WORK . . .

This is how Creole's Conservation Plant, Tia Juana No. 2, will look when completed, early in 1957. It will conserve 120% *more* gas than its earlier counterpart. 300 concrete piles, each 200' long and weighing about 90 tons, will be sunk in 79 feet of water to support the structure. Plant dimensions will be 440' long and 131' wide.

BOOST OIL YIELD!

Twelve Westinghouse gas turbines to give Creole Petroleum largest single concentration of gas turbine power in the world

Creole Petroleum Corporation, a Standard Oil Company (New Jersey) affiliate, is using one of today's newest prime movers in their program to increase oil field yields—the Westinghouse gas turbine. These twelve gas turbines, with a total output of 96,000 hp, will drive Ingersoll-Rand centrifugal compressors which will compress natural gas for injection into the oil field which is under Lake Maracaibo and the surrounding area. This gas conservation plant will recover substantial quantities of additional petroleum and conserve large quantities of gas in the Creole Venezuelan field.

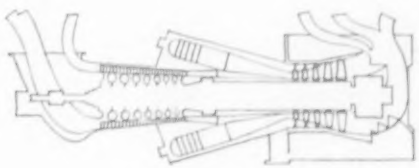
Westinghouse gas turbine power plants are finding new uses every day. They include:

- Expander turbine in nitric acid operations
- Mobile power plant for furnishing emergency power
- Pipeline pumping—driving centrifugal compressors
- Power generation in remote areas
- Peak period power for such loads as air conditioning and heat pumps

The basic reasons for selection of Westinghouse gas turbines by Creole Petroleum are the same ones which have made this new prime mover so successful: Demonstrated reliability and simplicity. Westinghouse gas turbines have given many thousands of hours of trouble-free operation both in the United States and in South America. And with just one basic moving part, their simplicity, light weight and absence of vibration greatly simplify the construction of any building or supporting structure. The twelve gas turbines for Creole Petroleum, for example, will be installed on a platform supported by concrete piling, some 90 feet above the lake bed.

Complete facilities for application and manufacture of gas turbines are located at the Westinghouse Electric Corporation plant at Lester, Pa. Gas turbine specialists are ready to assist in a careful analysis of how this new prime mover can do a mechanical drive or power generating job more reliably and economically. They are backed by extensive gas turbine manufacturing facilities making a full range of sizes.

Put this new prime mover to work by contacting your Westinghouse sales engineer; or write for copies of two books on gas turbines: B-5887 for power generation; and B-5859 for mechanical drive applications. Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-50587-B

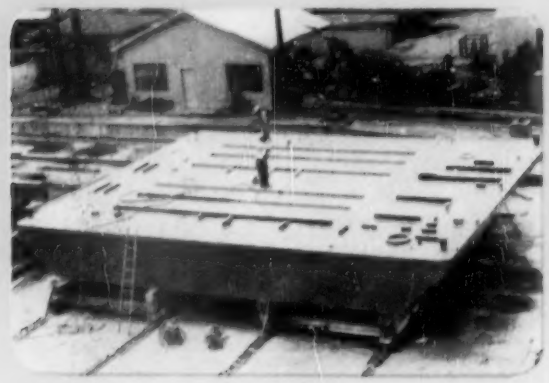


YOU CAN BE SURE...IF IT'S

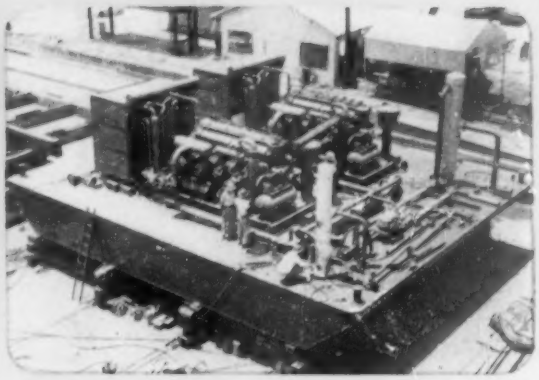
Westinghouse

Higgins Meets Unusual Needs of The Texas Company

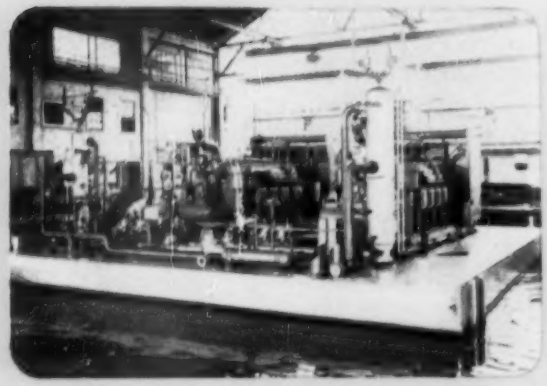
Delivers Floating Compressor Station . . . Right on Time



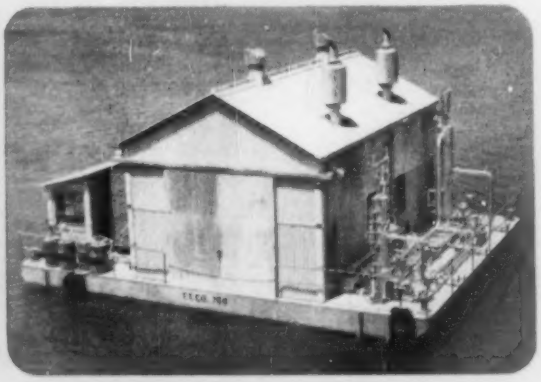
Specifications of The Texas Company were exacting. For instance: ". . . barge shall be designed for stability afloat to withstand a 120-mph wind load." Seaworthiness was no new problem to the designers and builders of world-famous Higgins wartime craft. However . . .



This barge was to measure only 46' l.o.a. x 38' beam x 5' draft—yet had to hold ". . . 2 gas engine driven compressor units; 2 gas driven, continuous duty 5kw generators; a compressor building; a generator building . . ." to say nothing of . . .



". . . all necessary piping, regulators, meter runs, orifice fittings, meters, valves, special valves fittings, drains, electrical system . . ." and even a good deal more. All this to be installed as ". . . an integral operating compressor station." What's more . . .



All this was wanted by a definite date—for in the oil business time always means money. Once again, Higgins lived up to its slogan—using the skills and equipment of its yard to deliver the job *right* on time.

Q. Got a marine problem? **A. Get hold of Higgins INC.**

THE NAME THAT MEANS DEPENDABILITY TO OUR FIGHTING FORCES

Box 8001 • New Orleans 22, La. • CRescent 0631

DRILLING BARGES • DREDGES • BARGES • QUARTER BOATS • TUGS • WORK BOATS • COMMUNICATION CRAFT • DRILLING STRUCTURES • PERSONNEL BOATS • PLEASURE BOATS • SEISMOGRAPH BOATS • BULK-TYPE CARGO BARGES • SWAMP SKIPPERS • TANK BARGES • ALSO MARINE REPAIRS OF ALL TYPES

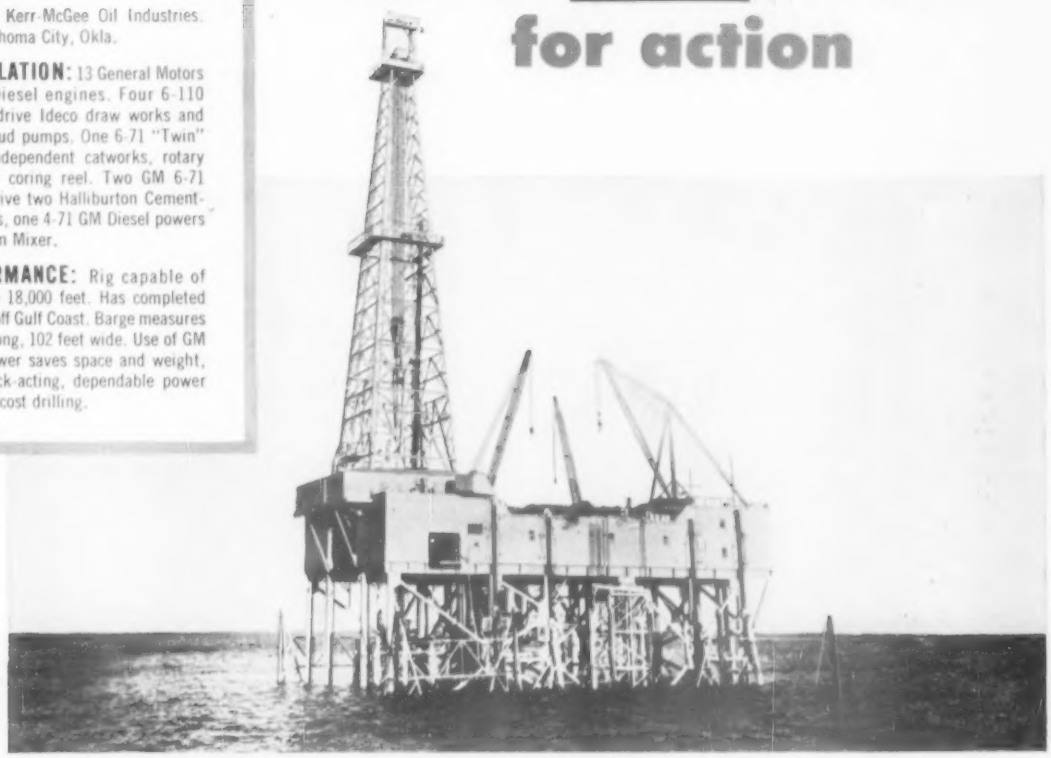
GM DIESEL
CASE HISTORY No. K-255

OWNER: Kerr-McGee Oil Industries, Inc., Oklahoma City, Okla.

INSTALLATION: 13 General Motors 2-cycle Diesel engines. Four 6-110 "Twins" drive Ideco draw works and Triplex mud pumps. One 6-71 "Twin" powers independent catworks, rotary drive and coring reel. Two GM 6-71 Diesels drive two Halliburton Cementing Pumps, one 4-71 GM Diesel powers Halliburton Mixer.

PERFORMANCE: Rig capable of drilling to 18,000 feet. Has completed first well off Gulf Coast. Barge measures 140 feet long, 102 feet wide. Use of GM Diesel power saves space and weight, gives quick-acting, dependable power for lower-cost drilling.

Clears more deck for action



ON ANY rig, the trim, space-saving design of General Motors 2-cycle Diesel engines really pays off. Offshore, they can be mounted on a smaller barge—yet give you more work-space on deck. On land, they're easy to load on trucks—can be moved without special road permits.

And GM Diesels give you the power you need in a smaller, lighter engine. Their *2-cycle* operation delivers power on every piston downstroke for faster acceleration and a smoother power flow that helps you make hole faster, at less cost.

What's more, you always find GM Diesel factory-authorized service available when and where you need it. GM Diesel distributors—with a complete stock of *factory* parts—blanket the oil fields.

Get acquainted with the GM Diesel distributor nearest you. He'll be glad to recommend the best GM Diesel model for your drilling needs.

DETROIT DIESEL ENGINE DIVISION

GENERAL MOTORS • DETROIT 28, MICHIGAN

Single Engines . . . 30 to 300 H. P. Multiple Units . . . Up to 893 H. P.

GM GENERAL MOTORS DIESEL POWER

GENERAL MOTORS CORP., DIESEL ENGINE SALES, PETROLEUM INDUSTRY, 1504 PHILTOWER BLDG., TULSA, OKLAHOMA

ALABAMA—
Albertville, Birmingham, Montgomery
ARMSTRONG EQUIPMENT CO.

CALIFORNIA—Bakersfield
LAWLESS BROTHERS, INC.
Berkeley
WEST COAST ENGINE & EQUIPMENT CO.
El Cajon
DEAKINS-LANE DIESEL CO.
Los Angeles
ANDERSON-O'BRIEN CO.
Ventura
GEM EQUIPMENT CO.

COLORADO—Denver
THE COLORADO BUILDERS' SUPPLY CO.
Fort Morgan
D & H DIESEL POWER, INC.

ILLINOIS—Mt. Carmel
WESTERN SERVICES

KANSAS—Great Bend, Wichita
DIESEL EQUIPMENT CO.

LOUISIANA—Alexandria
UNITED TOOL CO.
Harvey
GEORGE ENGINE CO., INC.
Shreveport
UNITED TOOL CO.

MICHIGAN—Detroit, Grand Rapids
EARLE EQUIPMENT CO.

MISSISSIPPI—Jackson
TAYLOR MACHINERY CORP.

MISSOURI—St. Louis
WESTERN MACHINERY & ENGINE CO.

NEW MEXICO—Albuquerque
HARRY CORNELIUS CO.

NORTH DAKOTA—Williston
SWEENEY BROTHERS

OKLAHOMA CITY—Oklahoma City, Tulsa
DIESEL POWER CO.

TEXAS—Corpus Christi, Dallas, Houston, Lubbock, Odessa, San Juan
STEWART & STEVENSON SERVICES, INC.
Pasadena
DIESEL POWER, INC.

UTAH—Moab, Salt Lake City
CATE EQUIPMENT CO., INC.

WYOMING—Kaycee, Casper
WESTERN OIL TOOL & MFG. CO., INC.

IN CANADA—Distributors in all key locations, under
GENERAL MOTORS DIESEL LTD.
London, Ontario

Texas oil companies prove the value of split channel radio operation

G-E narrow band equipment serves Loffland Brothers, Standard of Texas, and Seaboard Oil Company

In the Texas oil fields they'll tell you that *practical* split channel radio operation is proving its worth right now. Two major oil companies and a major drilling contractor, operating in an area pointing north from Odessa to Vealmoor and Snyder, have cooperated in establishing three independently operated systems in a range that formerly served two firms.

Rather than share a channel when Loffland installed radio in the area covered by Standard's 48.74 MC frequency and Seaboard's 48.78 MC allocation, the three firms decided to work on an experimental split channel basis. Slight modification of G-E equipment in use narrowed the spacing from 40 KC to 20 KC, permitting Loffland Brothers' new General Electric radios to go on the air on 48.76 MC.

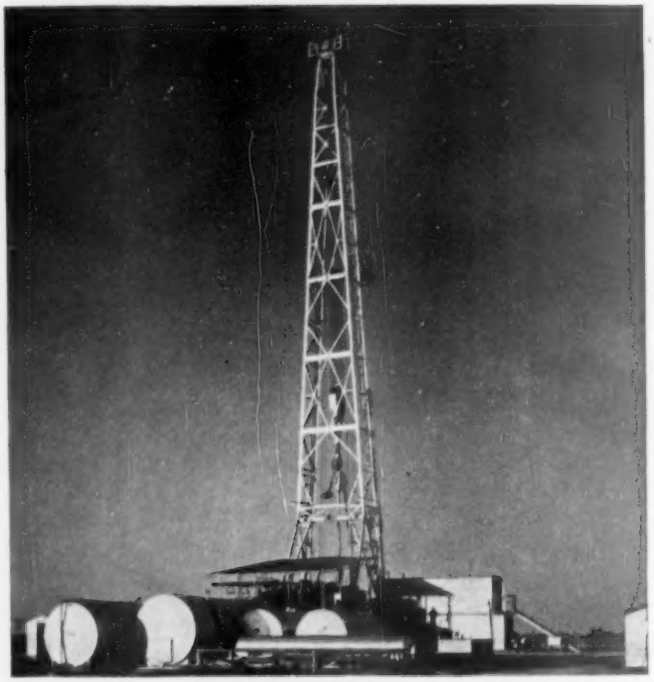
Clear channels for all

Now, each firm operates on its own frequency, without interference from either of the others. Because of split channel operation and General Electric narrow-band radio equipment, three companies benefit from 2-way radio communications without interference to one another.

The new G-E Progress Line of 2-way radio equipment provides a complete interchangeable package. Transmitter, receiver, power supply, and optional chassis are individually rack-mounted. Plug-in design permits quick changes of frequency, power, or type of reception.

2-WAY MOBILE RADIO

Your General Electric Communications Counselor will be pleased to cooperate with you in planning a split channel operation for your company. Call him in, or write today to: *Section X8115-7 General Electric Company, Communication Equipment, Electronics Park, Syracuse, New York.*



RADIO ANTENNA CAPS LOFFLAND BROTHERS' RIG near Odessa, Texas. Nine General Electric base stations and mobile radio units have cut $400 per month from former telephone costs.

STANDARD OIL OF TEXAS operates two G-E 60-watt base stations linking seven mobile units with the main base at Snyder, Texas. Radio speeds orders, makes instant decisions possible for fast action.

SEABOARD OIL COMPANY maintains instant operational contact with field locations through 5 G-E base stations. 20 mobile units coordinate widespread drill site activities in the West Texas area.

Progress Is Our Most Important Product

GENERAL ELECTRIC

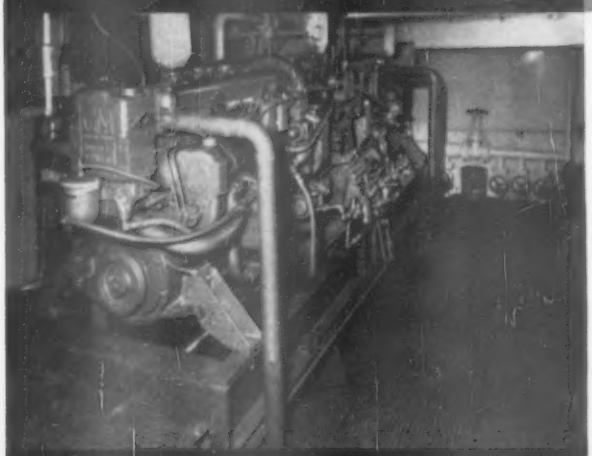
FOR DEPENDABLE POWER,

YOU CAN'T BEAT GM DIESEL

FOR DEPENDABLE SERVICE,

YOU CAN'T BEAT STEWART & STEVENSON

The new Drilling Barge Tender "Geo. Falgout" is 125 feet long by 30 feet beam by 9 feet draft. It is certified to carry 450 tons of liquid or dry cargo.



One of two 600 hp GM 6-110 tandems installed in the "Geo. Falgout." Auxiliary electric power is supplied by two 30 KW Stewart & Stevenson marine type generator sets.

THIS MAKES IT 33

Stewart & Stevenson Services have now furnished 33 GM Diesels in the offshore exploration and production fleet of Falgout Boat Company, Inc.

T. J. Falgout, President, has tried many makes of engines during the last twenty years. He now uses GM engines and Stewart & Stevenson Service exclusively because, he says "you can't beat that combination for dependability and economy."

STEWART & STEVENSON SERVICES, INC.

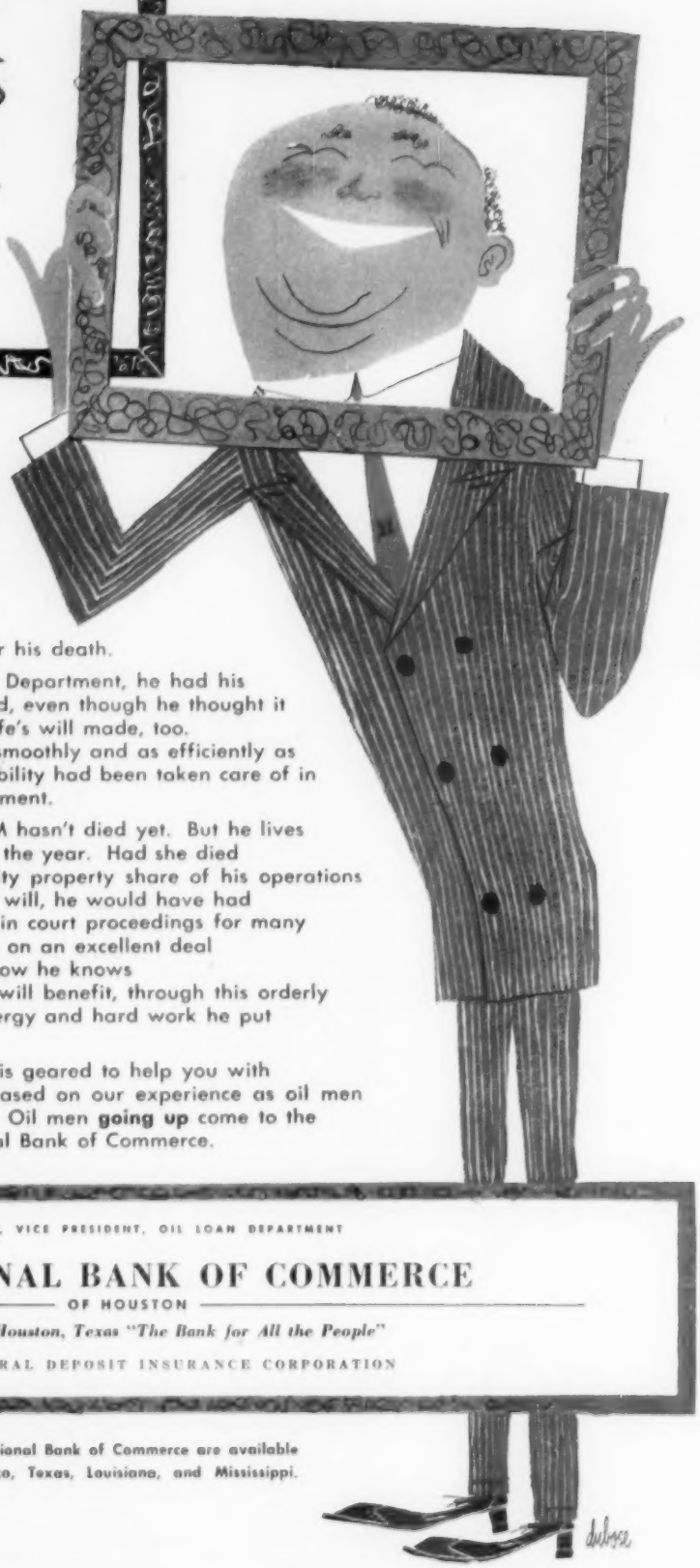
CHRYSLER GM diesel power CLIMAX

Main Office and Plant: 4516 Harrisburg Blvd., Houston 11, Texas. Phone CApitol 5-5341
Branches: Corpus Christi, Dallas, Lubbock, San Juan, Odessa.
Representatives: San Antonio, Longview, Brownsville.
Distributors of: General Motors Diesel Engines, Climax Blue Streak Engines, Chrysler Industrial and Marine Engines, Petter Diesel Engines.
Fabricators of: Electric Power Units, Electrical Control Equipment, Portable Pumping Units, Red Head Pumps.

STEWART & STEVENSON

THE NATION'S LARGEST DISTRIBUTORS OF GM DIESEL ENGINES

Mr. "M" was the picture of health



Mr. M. was in the best of health, and when we first suggested that he take certain steps in case of death he thought it was a lot of needless trouble. We showed him how our Trust Department could arrange his affairs in an orderly way, and allow his operation to continue after his death.

Following the advice of our Trust Department, he had his lawyer draw up a will for him. And, even though he thought it was a waste of time, he had his wife's will made, too. His finances were set up to run as smoothly and as efficiently as his oil operation. Every future possibility had been taken care of in the plans made by the Trust Department.

Now this story has a twist. Mr. M hasn't died yet. But he lives in Texas, and his wife died early in the year. Had she died without a will, and if her community property share of his operations had not been taken care of by such will, he would have had a sizable part of his estate tied up in court proceedings for many months. He would have missed out on an excellent deal which he was able to make. And now he knows that when he does die his children will benefit, through this orderly financial arrangement, from the energy and hard work he put into building his holdings.

The National Bank of Commerce is geared to help you with your problems. Impartial advice, based on our experience as oil men and money men will help you, too. Oil men **going up** come to the Oil Loan Department of The National Bank of Commerce.

E. O. BUCK, VICE PRESIDENT, OIL LOAN DEPARTMENT

THE NATIONAL BANK OF COMMERCE

OF HOUSTON

Gulf Building, Houston, Texas "The Bank for All the People"

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Facilities of the Oil Loan Department of The National Bank of Commerce are available in Wyoming, Colorado, Nebraska, New Mexico, Texas, Louisiana, and Mississippi.

HUDSON Solo-aire and Combin-aire COOLING UNITS

minimize water consumption in the Pegasus Plant of Magnolia Petroleum Company, Midland County, West Texas

Pictured in the foreground is the HUDSON Combin-aire unit, with Solo-aire units in the background. Air is used directly for cooling in the Solo-aires where low temperatures are not required. The Combin-aire uses a small quantity of water to precool the air so that entering hot fluids may be cooled to effluent temperatures lower than those obtainable by direct use of air.

If the total heat load of this plant had been dissipated thru a conventional cooling tower, 158 million gallons of water per year would have been required for makeup. The actual annual water makeup for the plant is only 17 million gallons per year. In this plant the use of the Solo-aire and Combin-aire have proven advantageous, resulting in savings in first cost, in operating costs for horsepower, water treating, and maintenance, and in obviating necessity for drilling of several water wells. Savings in cost of piping result thru installing the Combin-aire in close proximity to process equipment, made possible because the effluent high temperature air is always under-saturated with water vapor and nuisance and high maintenance cost due to water carryover or condensation are eliminated.

New bulletin
"Cooling with Air"
mailed upon request

HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

Accurate, Automatic Temperature Control

Hudson Solo-aire or Combin-aire units, or water cooling towers may be equipped with Auto-Variable pitch fans. Minute changes in cooled fluid outlet temperature immediately and automatically changes pitch of fan blades increasing or decreasing air flow. Control is effective despite changes in heat load or hot fluid inlet temperature; and over ambient air temperature range of more than 150° F.

Compared with fixed-pitch fans, Hudson Auto-Variable fans effect power *savings* of as much as 85%, depending upon actual versus design air temperatures.

Hundreds of auto-variable pitch fans from 6 to 18 feet in diameter are providing accurate, trouble-free, temperature control without necessity for shutters, louvers or by-passes, and with large power savings.

HUDSON AUTO-VARIABLE PITCH FANS

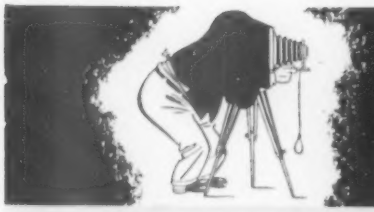
- **Accurately control temperature.**
- **Effect major savings in power.**
- **Reduce cost of control equipment.**
- **Eliminate by-pass piping.**
- **Prevent freezing even in extremely cold weather.**
- **Operate with standard pneumatic instruments.**
- **Have all moving parts of control mechanism completely enclosed and weather-proofed.**

Hudson designs and manufactures cooling systems using water exclusively, air exclusively, and combinations of air and water. Objective comparisons are furnished without cost.

Hudson Auto-Variable Pitch Fan is protected by U. S. patents and patents pending.

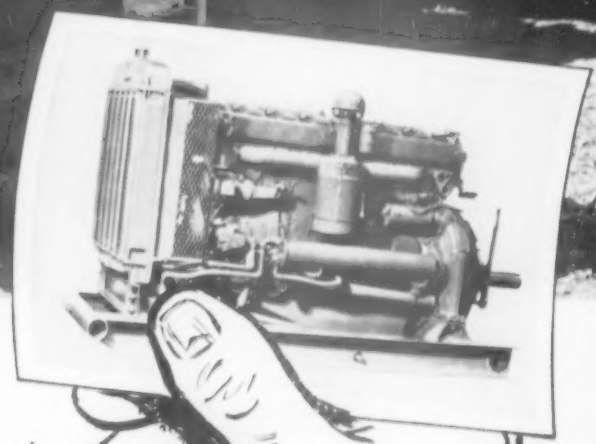
HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS



MURPHY DIESEL IN THE PICTURE

Two Murphys power this rig owned by Leon C. Smitherman Drilling Co.



...makes more hole at less cost

The best rig in the world can't be any more efficient than its power plant. And that's why more and more drillers are turning to Murphy Diesel Power. Heavy duty Murphy Diesels offer an exclusive combination of design features that make it possible for you to make more hole per dollar of power costs. With Murphy Diesel in the picture you get greater fuel economy, longer life and dependability unmatched by any other engine of comparable size. Ask your Murphy Diesel Dealer to give you the whole story.

MURPHY DIESEL COMPANY
5305 W. Burnham St., Milwaukee 14, Wisconsin
FACTORY BRANCH: Sales, Parts and Service—113-116 S. Elwood St. Tulsa, Oklahoma

316

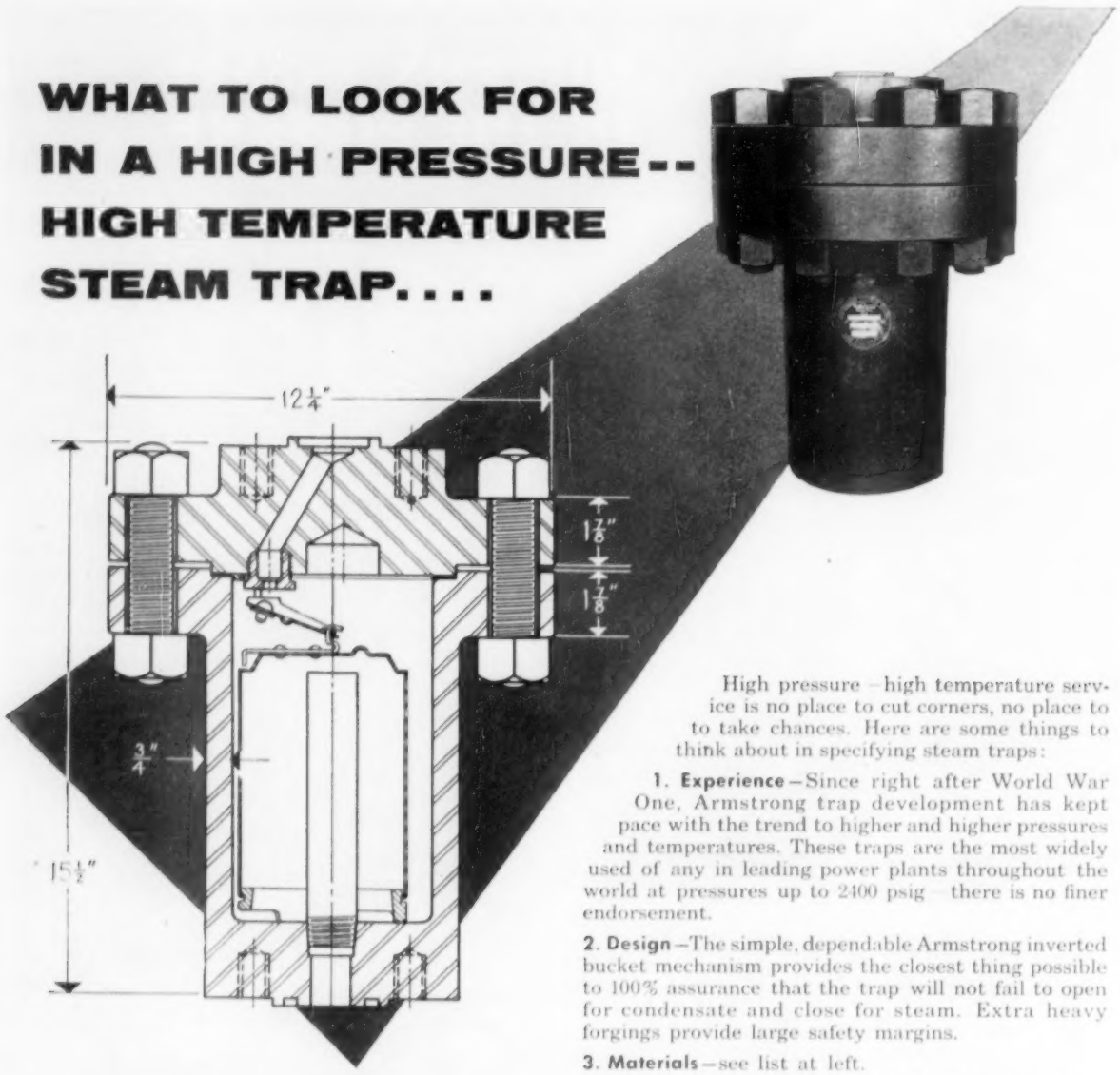
MURPHY DIESEL

SEE YOUR MURPHY DIESEL DEALER, TODAY—

ALBUQUERQUE, NEW MEXICO, Lively Equipment Company; BUTTE, MONTANA, Hall-Perry Machinery Company; CORPUS CHRISTI, TEXAS, Houston Engine & Pump Company; DALLAS, TEXAS, Conley-Lott Machinery Co.; DENVER, COLORADO, Macdonald Equipment Co., Inc.; EDMONTON, ALBERTA, CANADA, Northern Engine & Equipment Co., Ltd.; GREAT BEND, KANSAS, Manufacturers Dist. Co.; GREAT FALLS, MONTANA, Hall-Perry Machinery Company; HOUSTON, TEXAS, Houston Engine & Pump Co., Inc.; JACKSON, MICHIGAN, Utility & Industrial Supply Co.; LOS ANGELES, CALIFORNIA, Industrial Engine Service; LUBBOCK, TEXAS, Conley-Lott Machinery Co.; SAN ANTONIO, TEXAS, The Roy Klossner Company; BAKERSFIELD, CALIFORNIA, Glenn Rose Engine Service; ODESSA, TEXAS, Conley Lott Machinery Co., ODESSA, TEXAS, Harries Sales & Rental, P. O. Box 1568; LONGVIEW, TEXAS, Conley-Lott-Nichols Machinery Co.

TULSA, OKLAHOMA, SALES, PARTS AND SERVICE—113-117 S. ELWOOD ST.

WHAT TO LOOK FOR IN A HIGH PRESSURE-- HIGH TEMPERATURE STEAM TRAP....



High pressure—high temperature service is no place to cut corners, no place to to take chances. Here are some things to think about in specifying steam traps:

1. Experience—Since right after World War One, Armstrong trap development has kept pace with the trend to higher and higher pressures and temperatures. These traps are the most widely used of any in leading power plants throughout the world at pressures up to 2400 psig—there is no finer endorsement.

2. Design—The simple, dependable Armstrong inverted bucket mechanism provides the closest thing possible to 100% assurance that the trap will not fail to open for condensate and close for steam. Extra heavy forgings provide large safety margins.

3. Materials—see list at left.

4. Price—Armstrong forged steel trap list prices range from $95 to over $1000. The No. 515 shown above is rated for 1500 psig at 900°F and for 2000 psig at 600°F. It lists at $500. Armstrong prices are moderate for what you get because of high production. *There is no compromise made at the expense of safety, quality and low maintenance.*

Want more facts?—Call your local Armstrong Representative or write: Armstrong Machine Works, 868 Maple Street, Three Rivers, Michigan.

Do you have Catalog J?—This 44-page Steam Trap Book is free on request.

LIST OF MATERIALS
ARMSTRONG FORGED STEEL TRAPS

Part	Material
CAP AND BODY FORGINGS	
Up to 600 psi, 750°	1030 carbon steel
Up to 900 psi, 900°	ASTM Spec. F-1 carbon moly steel
Up to 2500 psi, above 900°	ASTM Spec. F-5 chrome moly steel
VALVE AND SEAT	Type 440 chrome steel, heat treated, standard. Stellite available.
LEVER MECHANISM	Stainless steel
BUCKET	Stainless steel
BOLTS	Class C high tensile, high temperature bolting material—125,000 min. tensile.
NUTS	Hex, semi-finish, heat treated for high pressure, high temperature service.
GASKET	Compressed graphited asbestos
INLET TUBE	Wrought iron

STEAM TRAPS FOR EVERY REQUIREMENT — APPLICATION ENGINEERED

ARMSTRONG STEAM TRAPS

LONGER LIFE
from your Drill Collars with...
ROL·FLEX
Replaceable End Drill Collars!

The American Iron Rol-Flex Drill Collar with Straight Grip Drill Collar connectors enables you to replace worn or broken connections right at your rig with no loss of collar length, no trucking expense for re-threading and no reduced bit weight while waiting for shopped collars.

The Rol-Flex Drill Collar Tool Joint is designed especially for use on a drill collar and uses the Straight Grip threads with the famous 4 points of seal. The critical last engaged thread area on the drill collar incorporates a cold working process from which is derived the name "Rol-Flex."

The Rol-Flex process on this last engaged thread area removes the most dangerous breakage point on the drill collar by eliminating the fatigue notch where stresses are normally concentrated and dissipates the stresses over a greater area.

Important Features:

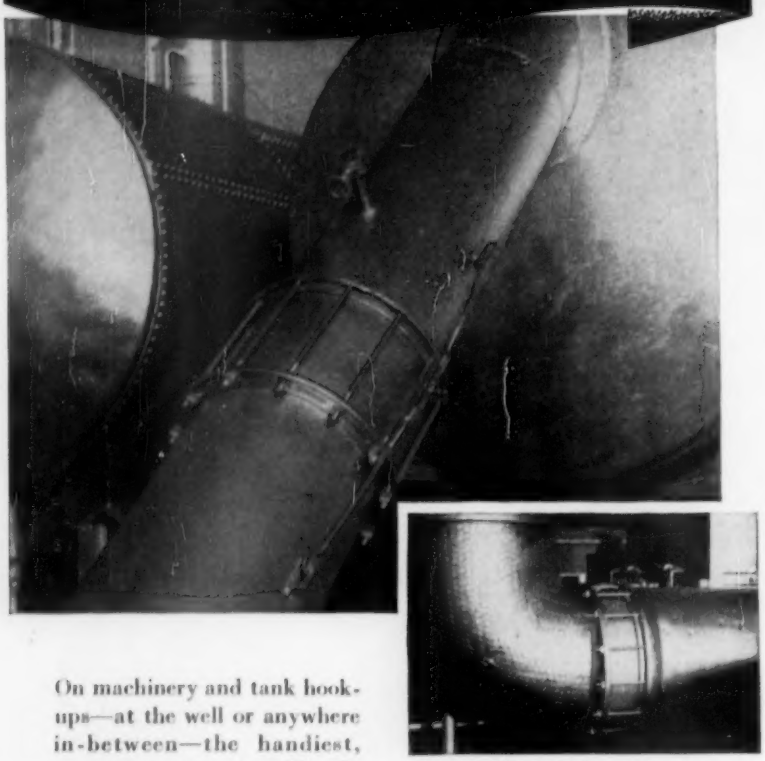
- Installed at your rig.
- Tool joint connectors designed for optimum Drill Collar usage.
- No loss of collar length.
- Removal of "Fatigue Notch" from collar.
- Cold working "(Rol-Flex)" of undercut on Drill Collar.

AMERICAN IRON & MACHINE WORKS CO. MANUFACTURERS OF OIL FIELD EQUIPMENT A REG. U.S. PAT. OFF. OKLAHOMA CITY U.S.A.

AMERICAN IRON & MACHINE WORKS CO.

OKLAHOMA CITY, OKLA. — BOX 1177

on equipment hookups... the DRESSER way is easier...surer!



TOP—20" Style 38 Dresser Coupling installed on field gas scrubber line. BELOW—24" coupling in gas-treating plant.

On machinery and tank hookups—at the well or anywhere in-between—the handiest, surest way to get uniformly tight pipe joints is with Dresser Couplings or Long Sleeves.

There's no pipe threading—the only tool you need is a wrench. Dresser Couplings give you bottle-tight connections every time—day or night, rain or shine—even when pipe ends don't meet.

AVAILABLE AT LEADING OILFIELD SUPPLY STORES

Style 38 Coupling | Style 40 Long Sleeve | Hydrepair*Asbestos Cement Pipe Clamp | Style 63 Expansion Joint | Style 39 Insulating Coupling

*HYDREPAIR is a trade-mark of Dresser Manufacturing Division

DRESSER®

ONE OF THE DRESSER INDUSTRIES

Dresser Manufacturing Division, 49 Fisher Ave., Bradford, Pa.
Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Airport Blvd., S. San Francisco, Calif.

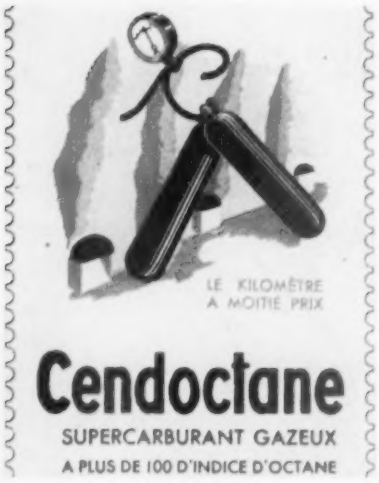
They Say—

Natural Gas for Autos

Dear Sir:

In your September 5 issue, page 47, you give information on the use of natural gas as motor fuel for cars in Northern Italy since the discovery of gas in the Po Valley a few years ago.

I wish to point out that such a use



of natural gas is common in Southwestern France since the development in 1942 of the St. Marcet field by the French Government owned Regie Autonome des Petroles. Natural gas used as motor fuel is sold under the name of "Cendoctane" that means "Octane Number 100." Its use procures to the customers substantial savings, compared to the use of gasoline, premium or regular, which, as you might know, are charged in France as well as in Italy by important taxes.

For your documentation, I send you herewith a stamp we edited a few years ago for "Cendoctane" advertising (See photo).

I hope I have not disturbed you too much, and remain.

J. P. LaCroix
Exploitation Manager
Regie Autonome des Petroles
Saint-Gaudens (H.G.), France.

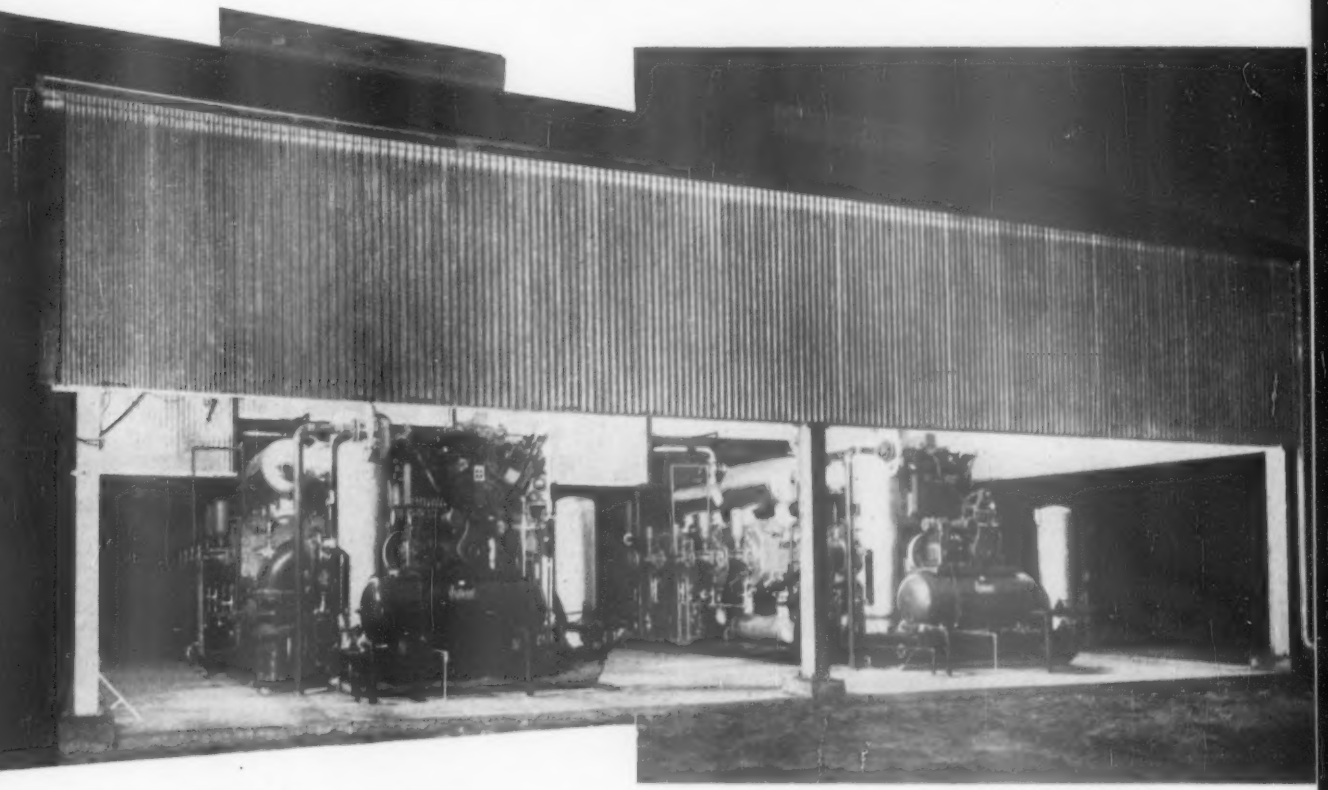
More News on 'River-Frac'

Dear Sir:

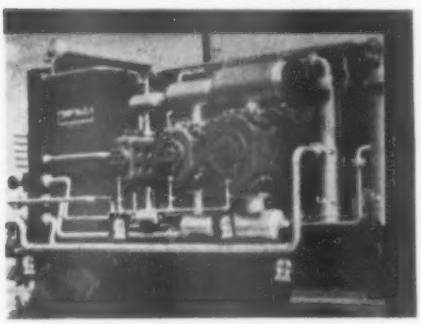
As an employe of El Paso Natural Gas Co. I was surprised to read, in your article in the Journal, October 3, 1955, *("River-Frac" Pays Off, page 90)* that Dowell Incorporated had performed the first water-frac treatment in the San Juan basin. My surprise

Southwest

PACKAGED COMPRESSOR PLANTS



Ohio Oil Company's packaged compressor plant, North Cotton Valley Field, Louisiana. Equipped with two Southwest — Cooper-Bessemer 500hp GMXA8, eight cylinder, two cycle, gas engine driven compressors.



A Modest Investment Means Flare Gas Can Be Sold

Gas which formerly had been wasted by flaring is now being sold and used for fuel. But making profitable use of waste does not require a capital outlay possible only by large companies. The **installed** cost of Southwest Packaged Compressor Plants is much lower than that of stationary units. They are within the range of any operator who wants to improve his operation. Packaged units with automatic control equipment for unattended operation offer further savings in labor costs. At the Ohio installation, one pumper on one shift takes care of maintenance and operation.

Estimated life of the wells in this field is from five to ten years. At that time the Southwest plant can be picked up and put down to work again in a new field. Be sure to look into **all** the economies of a Southwest Packaged Compressor Plant.

SOUTHWEST INDUSTRIES, INC.

Post Office Box 7773 Houston 7, Texas

GROUND-LEVEL ASSEMBLY SAVES TIME... CUTS COSTS

EMSCO B-127 Masts give you a money-saving combination of maximum portability and faster, easier assembly.

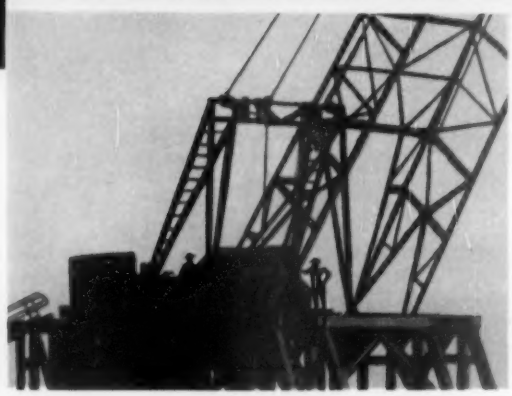
Mast and substructure of the B Series Masts are designed as a unit to permit ground level assembly. This reduces rig-up time, provides safer working conditions, and allows the use of smaller gin pole trucks in assembly.

The B Series Mast is a sound, rigid structure with a minimum of internal bracing. Four-legged construction permits safe, continuous and positive line control during erection. The erection gin pole is separate and carries none of the working load.

Rear legs of the mast are pinned into their pedestals on top of the substructure and the front legs are cradled within. Pivoting on its rear legs, the mast is raised from ground level in a smooth, continuous operation, utilizing only the power of the hoist.

The mast can be transported in one piece on auxiliary wheels or tracks or nested into sections of roadable widths. Barge installations are ideal since the mast does not have to be snubbed into place on being raised, or pulled off center on being lowered.

Contact your EMSCO representative for details on EMSCO B Series Masts.



EMSCO

REG. U.S. PAT. OFF.

EMSCO MANUFACTURING COMPANY

Houston, Texas • LOS ANGELES, CALIF. • Garland, Texas

General Sales Offices: Dallas, Texas

AVAILABLE THROUGH LEADING SUPPLY STORES

E-202-55

was due to the fact that El Paso Natural, to all local accounts, was the originator of this type treatment in the "basin."

The most outlandish statement you made was that, "Most gas wells are now shut in for lack of market, although El Paso Natural Gas Co. is taking some gas to Albuquerque; but operators are anticipating ample outlet on completion of the Pacific Northwest Pipeline next year."

To advise you, the following items are brought to your attention:

. . . **Most wells** are not shut in.

. . . **El Paso Natural Gas Co.** has a very nice pipeline to the California markets and is passing 300 million cubic feet per day to these markets from the San Juan basin alone.

. . . **El Paso Natural Gas Co.** has no line to Albuquerque.

I hope to see a correcton of your article appear in the Journal at your convenience.

R. W. Allen, Chief Geologist
El Paso Natural Gas Co.

Editor's Note: Dowell still claims it's the first company to undertake a water-frac treatment. However, a company press release has stated Dowell undertook the original treatments "at the suggestion of El Paso Natural Gas Co." It also is our understanding that the only other company conducting such treatments is Halliburton Oil Well Cementing Co.

The author's statement that "most gas wells are now shut in for lack of market" referred only to the 20 wells treated by Dowell. If the sentence is interpreted as applying basinwide, then the writer is guilty of ambiguity. We are quite aware of the existence of El Paso's "very nice pipeline to the California markets."

On the last point—the line to Albuquerque—the writer enters a plea of absolute guilt. He failed to check his pipeline map. The line to Albuquerque is the property of Southern Union Gas Co.

End to the Mystery

Dear Sir:

Your October 17 issue of The Oil and Gas Journal has just been reviewed with great interest. On page 81 you have an editorial entitled "Taking Some Mystery Out of the Oil Business." This is a most interesting editorial and I agree most heartily with it.

As chairman of O.I.I.C. during the past year, I have tried to get this idea over at the many meetings which I have attended but have failed miserably compared to the brief and to the point manner in which you have handled the subject in this editorial.

Thank you so much for this fine

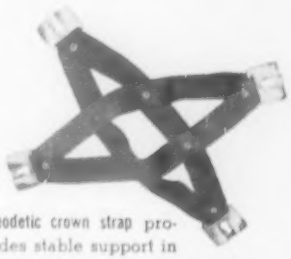
HERE'S WHAT WILLSON SUPER-TOUGH® HATS HAVE THAT NO OTHER SAFETY HAT HAS!

It takes more than a strong, tough hat shell to provide full head protection—*both external and internal!* Only Willson Super-Tough® Hats and Caps give you that *extra* protection!

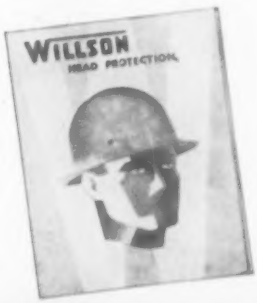
And that *extra* protection and wearer comfort is possible because of this unique, patented geodetic crown strap and pneumatic head band, developed by Cornell Aeronautical Laboratory, Inc.

Get the complete story on this new, revolutionary, scientific advance in head protection. Write for this new manual and catalog on head protection.

Super-Tough® hat cut away to show how the patented head gear fully cradles the head.



Geodetic crown strap provides stable support in all directions with no concentration of load in tie string on top of the head.



Patented pneumatic cushioned, all plastic head band providing scientific "metered air" shock absorption.

More Than 300 Safety Products Carry This Famous Trademark
WILLSON®

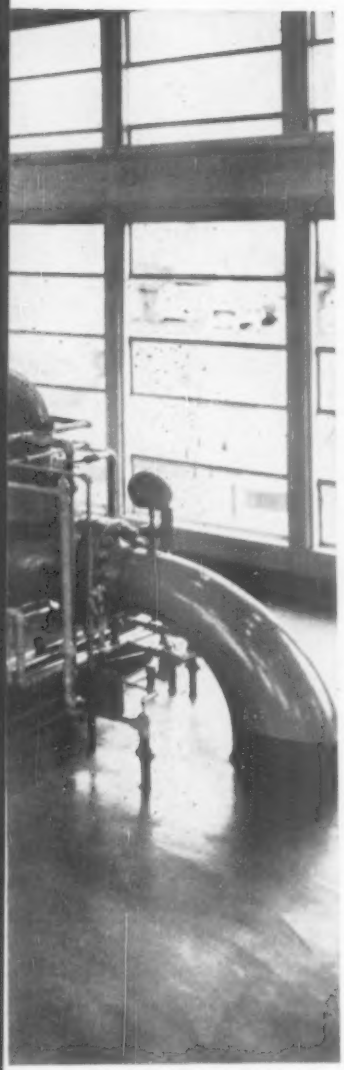
Leaders in Research and Development of Safety Equipment Since 1870

WILLSON PRODUCTS, INC., 204 WASHINGTON ST., READING, PA.

ENGINEERING
REPORTS:

NO FIREWALL IS NEEDED FOR THESE 1250-HP EXPLOSION-PROOF MOTORS

FLEXIBILITY of General Electric equipment is illustrated by these two photos. Easily installed G-E Limitamp (left) is pre-packaged at factory, requires minimum of maintenance. G-E control center substation (right) has been fitted at right angles to Limitamp without sacrificing safety or convenience. Equipment's design features permit maximum space utilization and may easily be expanded.



Wolverine's new station uses G-E electrical system for 4-million-gpd throughput

G-E explosion-proof motors at Kennedy station in Hammond, Indiana, include largest installed to date

The Wolverine Pipeline System, supplying Niles, Jackson and Detroit, Michigan, and Toledo, Ohio, was built for dependable year-round transportation of petroleum products. To help maintain an ultimate throughput of 4 million gallons per day, Wolverine selected General Electric equipment for their "showcase" Kennedy Station in Hammond, Indiana.

Working closely together, Wolverine and G-E engineers developed a flexible electrical system that economically co-ordinates the two largest G-E explosion-proof motors ever built up to the date of this installation—rated 1250 hp, 2300 volts, for Class I Group D location — with Limitamp* control, transformers, and a one-man station-control console. J. S. Cooper, Kennedy Station's chief operator, says, "Our G-E equipment—conveniently arranged and easily accessible for maintenance—has needed little or no attention since we started operating in January, 1954."

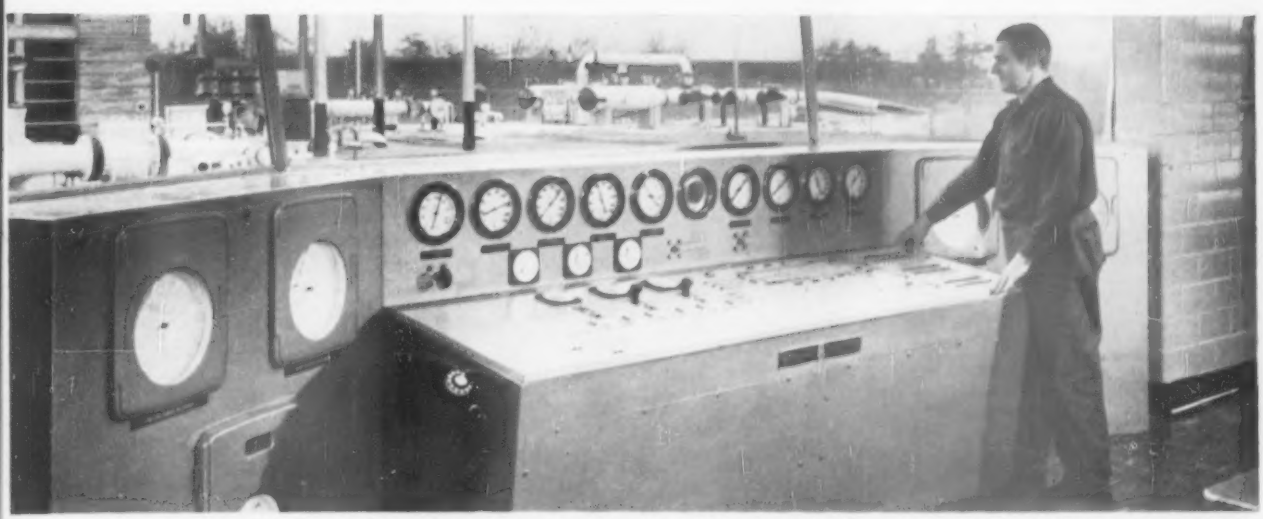
*Reg. Trademark of General Electric Co.

Here is another example to illustrate that, whatever *your* specific pipeline electrification problems, G.E. can help solve them—with a broad line of motors, control, and power-system equipment, engineered to your needs. For more information, contact your local G-E Apparatus Sales representative. General Electric Company, Schenectady 5, N. Y.

661-51

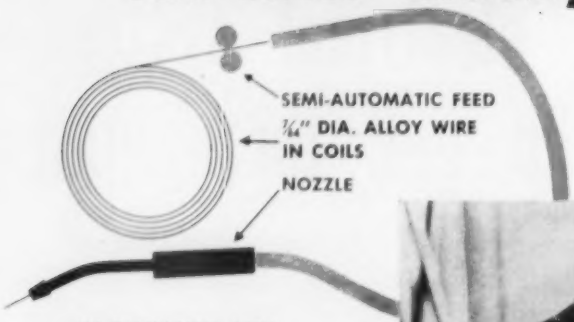
Engineered Electrical Systems for Oil Pipelines

GENERAL ELECTRIC



ONE MAN CONTROL of entire Kennedy station is possible with this control console, custom built by G.E. to meet Wolverine's special requirements. Top surface of console contains diagram of Wolverine's pipeline and shippers' feeder lines and tanks. Lights and gages show which valves, tanks, meters and pumps are in operation at any given moment.

SEMI-AUTOMATIC HARD-FACING with the NEW Stoody Alloy Tubular Wires



- bare wire...no flux
- complete visibility
- three times manual speed
- enormous savings in labor

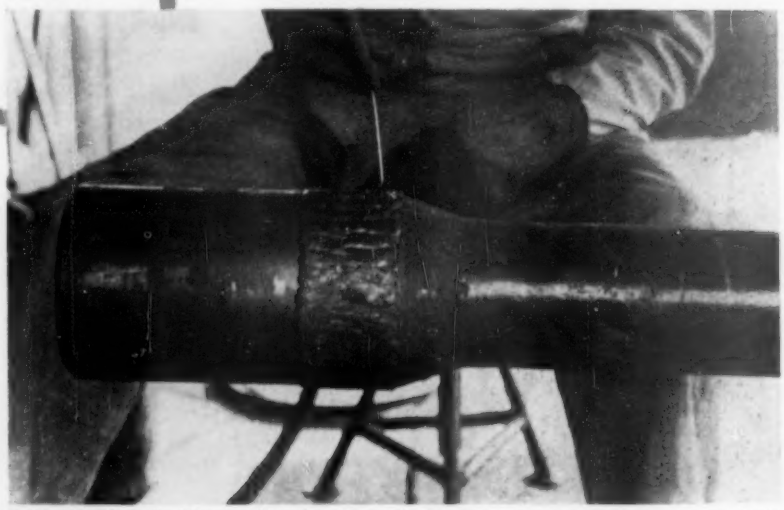
IN DRILLING AND PIPELINE OPERATIONS

This is a totally new hard-facing method utilizing the welding speed of the semi-automatic machine to produce sound deposits of wear-resistant alloys. The wires run bare, using no flux, so that the weldor enjoys full visibility at all times... deposition rates at normal welding currents (200 to 300 amps) are double or triple those of the manual method... standard semi-automatic equipment is easily converted to handle Stoody wires.

Maintenance time and welding costs are reduced through increased service life provided by Stoody alloys and the greatly increased welding speed. Weldors like the semi-automatic, find it easy to operate with less fatigue.

Your Stoody dealer (check the "yellow pages" of your phone book) will be glad to give you full information, plus a demonstration on your own equipment without obligation. Or write to the company for literature and the name of your nearest dealer.

STOODY COMPANY
11938 East Slauson Avenue
Whittier, California



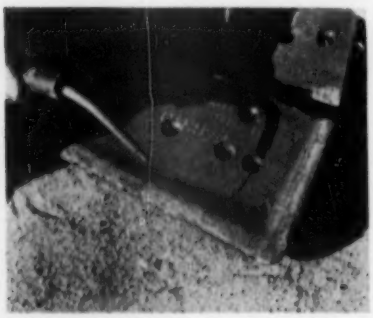
TOOL JOINTS: *Rebuilding and hard-facing with Stoody 100 cuts welding time to one half that of manual welding.*

SHOVEL BUCKETS: TEETH, LIPS, ADAPTERS, ETC., *Stoody 121 gives good wear resistance, quickly covers wearing areas on this clamshell and other types of buckets.*

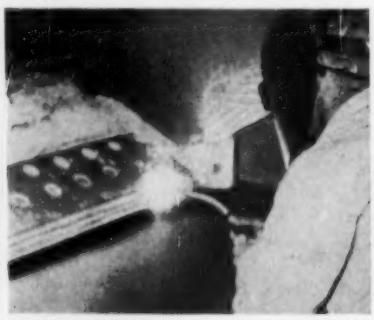
Stoody 100... a high chromium alloy wire for equipment subject to severe abrasion and impact. This is similar to Coated Tube Stoodite. Used on crushers, buckets, rippers, augers, tool joints. Deposits 10 to 18 pounds per hour.

Stoody 121... a medium alloy material with excellent resistance to abrasion and impact. This is similar to Stoody 21. For bucket teeth, shovels, grizzlies, loader lips, crushers. Deposits 9 to 16 pounds per hour.

Stoody Nickel Manganese... produces a Hadfield manganese deposit for build-up of all manganese parts—crushers, buckets, shovels, teeth—preparatory to hard-facing. Deposits 4 to 7 pounds per hour.



BULLDOZER END BITS: *Can be hard-faced in one third of time required by manual process. Stoody 121 is recommended.*



SCRAPER BLADES: *Parallel beads of Stoody 121 are fast and easy to apply to scraper blades, add excellent wear resistance.*

SHOVEL TRACK PADS: *Use of Stoody Manganese applied by semi-automatic welder cuts time on maintenance*

support and your interest in our program.

W. R. Huber
Manager Public Relations
Gulf Oil Corp.
Pittsburgh, Pa.

Hits Responsive Chord

Dear Sir:

I was certainly pleased to read your editorial in the October 17 issue of The Oil and Gas Journal entitled "Taking Some Mystery Out of the Oil Business."

I was certainly pleased to see the favorable comments you made regarding the work of the O.I.I.C.

James G. Kemm
District Representative
O.I.I.C.
Tulsa.

Orchids for The Journal

Dear Sir:

Your exploration column ("Statisticulating" for Oil) on page 319, October 10 issue, is an exceptionally well done job. It sums up brilliantly what the President of the A.A.P.G. feels is the most important message he can deliver to every local geological society he visits on the annual presidential tour. Obviously both President Knebel and Jersey Standard feel this is an important new concept in oil exploration thinking.

But—this all started with The Oil and Gas Journal—back about 1946 when the paper shortage began to ease up. We were looking for a new feature to add to the annuals and semiannuals. We came up with the idea of listing all the major fields and their ultimate size. We even picked the definition—100 million barrels or more ultimate production.

It was The Oil and Gas Journal that discovered and publicized the fact that this handful of major fields accounted for the overwhelming majority of all the oil found.

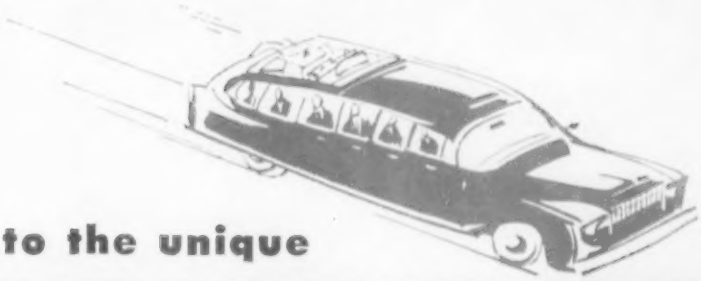
As a direct result of The Oil and Gas Journal material, Wallace Pratt, then in retirement, went to New York and persuaded Jersey officers to start a research attack on this idea.

Now we have Jersey beginning to release some of its results—and under the highest auspices.

We are in the midst of a major shift in oil exploration thinking. We are working on one of the most important single discoveries in oil exploration since the development of the Anticlinal Theory.

In a dignified, modest, institutional way, The Oil and Gas Journal should—from time to time—stake its claim to a place in the history of one of oil exploration's major idea develop-

We'll Whisk You Out...



to the unique

COLFOAM MICROBALLOON SPHERES

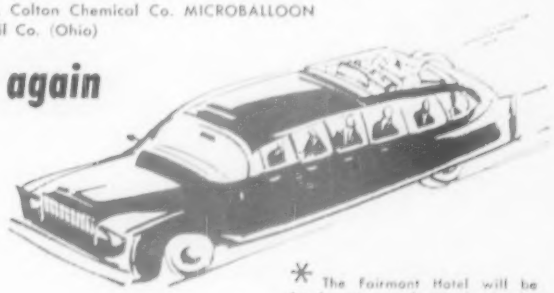
demonstration

See this working model, while you are at the API in San Francisco, that graphically demonstrates just how a Colfoam Microballoon* blanket—of microscopically-small, gas-filled spheres of urea formaldehyde—behaves inside oil and gasoline storage tanks . . . how the Spheres rise and fall with the fluid in the tanks to cut evaporation losses and save you money.

Enjoy Colton hospitality at the same time—meaning recreation and refreshments. For further details, phone Richard Engebrecht, of Braun-Knecht-Heimann Co., 1400 16th Street, where the demonstration will be held, Hemlock 1-8800.

*COLFOAM REG. T.M. Colton Chemical Co. MICROBALLOON
Reg. T.M. Standard Oil Co. (Ohio)

...and back again to your hotel *



* The Fairmont Hotel will be the departure and arrival point for convenient Limousine Service (identified with Colfoam Microballoon Spheres signs) every hour on the hour.

COLTON **COLTON CHEMICAL COMPANY**

A Division of Air Reduction Co., Inc.

1545 EAST 18TH ST., CLEVELAND 14, OHIO

SALES AGENTS: Braun-Knecht-Heimann Co., San Francisco, Cal.; Braun Corp., Los Angeles, Cal.; Van Waters & Rogers, Inc., Portland, Ore., Seattle, Wash. and Dallas, Texas; and Tank Service, Inc., Tulsa, Okla.

EXPORT AGENTS: Airco Company, International, New York 17, N. Y.

Products of other divisions of Air Reduction Co., Inc. include: AIRCO—industrial gases, welding and cutting equipment PURECO—carbon dioxide, liquid-solid ("DRY-ICE") OHIO—medical gases and hospital equipment NATIONAL CARBIDE—pipeline acetylene and calcium carbide

THIS battery of "Automatic" Sprinkler SUPROTEX-DELUGE valves is assurance of intensive fire-fighting power for this fluid catalytic cracking unit.

Heat-sensitive Rate-of-Temperature-Rise detectors, located throughout the superstructure of the plant, feel fire at inception. Then, in but a matter of seconds, scientifically engineered "Automatic" FIRE-FOG systems take over. Alarms sound, location of the blaze is determined, and fire control or extinguishment is an instantaneous accomplishment.

FIRE-FOG is but one of many advanced types of ENGINEERED Special Hazard PROTECTION developed by "Automatic" Sprinkler Corporation of America. Research into the cause of disastrous fires, endless testing, and much practical field experience has enabled us to design, manufacture, engineer and install the specific type of protection needed to combat every fire hazard. Fixed piping systems of "Automatic" Sprinklers, water spray, high and low pressure CO_2, Air Foam, Dry Powder and Chemical Foam stand guard over leading petroleum and chemical processing properties throughout the Western Hemisphere.

Our highly trained staff of Special Hazard engineers will gladly assist you in the development of a fire-safe, investment-saving future for your business. Write or call us for service today.

"Automatic" Sprinkler
CORPORATION OF AMERICA
YOUNGSTOWN, OHIO

Offices in Principal Cities of North and South America

ments. It isn't often that a trade journal can lay claim to such a place in history. But then The Oil and Gas Journal has never been an ordinary trade journal.

Charles J. Deegan
Petroleum Consultant
Dallas, Texas.

CALENDAR

1955

NOVEMBER

9-10 Society of Automotive Engineers, Golden Anniversary Fuels and Lubricants meeting, Bellevue-Stratford Hotel, Philadelphia.

10-11 American Association of Petroleum Geologists, Pacific Section annual convention, Biltmore Hotel, Los Angeles.

11-13 New Mexico Geological Society, in conjunction with Roswell Geological Society, sixth annual field conference, Truth or Consequences, N. M.

13-18 American Society of Mechanical Engineers, 75th anniversary meeting, Hilton and Blackstone Hotels, Chicago.

14-17 American Petroleum Institute, 35th annual meeting, Mark Hopkins, Fairmont, St. Francis and Palace Hotels, San Francisco.

18 Southern Gas Association, Transmission Section round-table conference on natural-gas drilling and production, Shamrock Hotel, Houston.

18-19 Society of Exploration Geophysicists, Southwest regional meeting, Dallas.

27-29 New Mexico Oil and Gas Association, Albuquerque, N. Mex.

27-30 American Institute of Chemical Engineers, annual meeting, Statler Hotel, Detroit.

DECEMBER

1-3 Interstate Oil Compact Commission, La Fonda Hotel, Santa Fe, N. M.

1-3 American Chemical Society, 11th southwest meeting, Shamrock Hotel, Houston.

2 Natural Gasoline Association of America, Panhandle-Plains meeting, Herring Hotel, Amarillo, Tex.

3 National Oil Scouts and Landmen's Association, annual meeting of board of directors, Adolphus Hotel, Dallas.

8-9 Oil Industry Information Committee meeting, Biltmore Hotel, New York City.

1956

JANUARY

9-13 Society of Automotive Engineers, annual meeting, Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

16-18 Pipe Line Contractors Association, eighth annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

FEBRUARY

15-17 National Association of Corrosion Engineers Short Course for Pipeliners, Mayo Hotel, Tulsa.

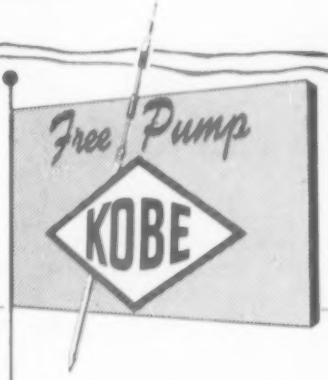
19-23 American Institute of Mining and Metallurgical Engineers, annual meeting, Hotel Statler, New York City.

24 Natural Gasoline Association of America, Permian Basin meeting, Lincoln Hotel, Odessa, Tex.

26-29 American Institute of Chemical Engineers, Statler Hotel, Los Angeles.

27-29 American Association of Petroleum Geologists, Rocky Mountain Section, Auditorium, Denver.

There's a better, easier way to pump oil wells, too...



Tackle an old problem in a new way and frequently you find it tremendously simplified. This is certainly the case with the Kobe *Free Pump* System of oil well pumping . . . some producers have found it easier to *Free Pump* wells than to flow them. As can be imagined, major economies result. The Kobe system frequently costs $2,000 to $4,000 per well less to install and 50% less to operate. If you are interested in such savings, why not drop us a line?

Our pictorial magazine, Pumping Trends, shows how KOBE is being used to simplify pumping problems everywhere. Write, we'll be happy to add your name to our mailing list.

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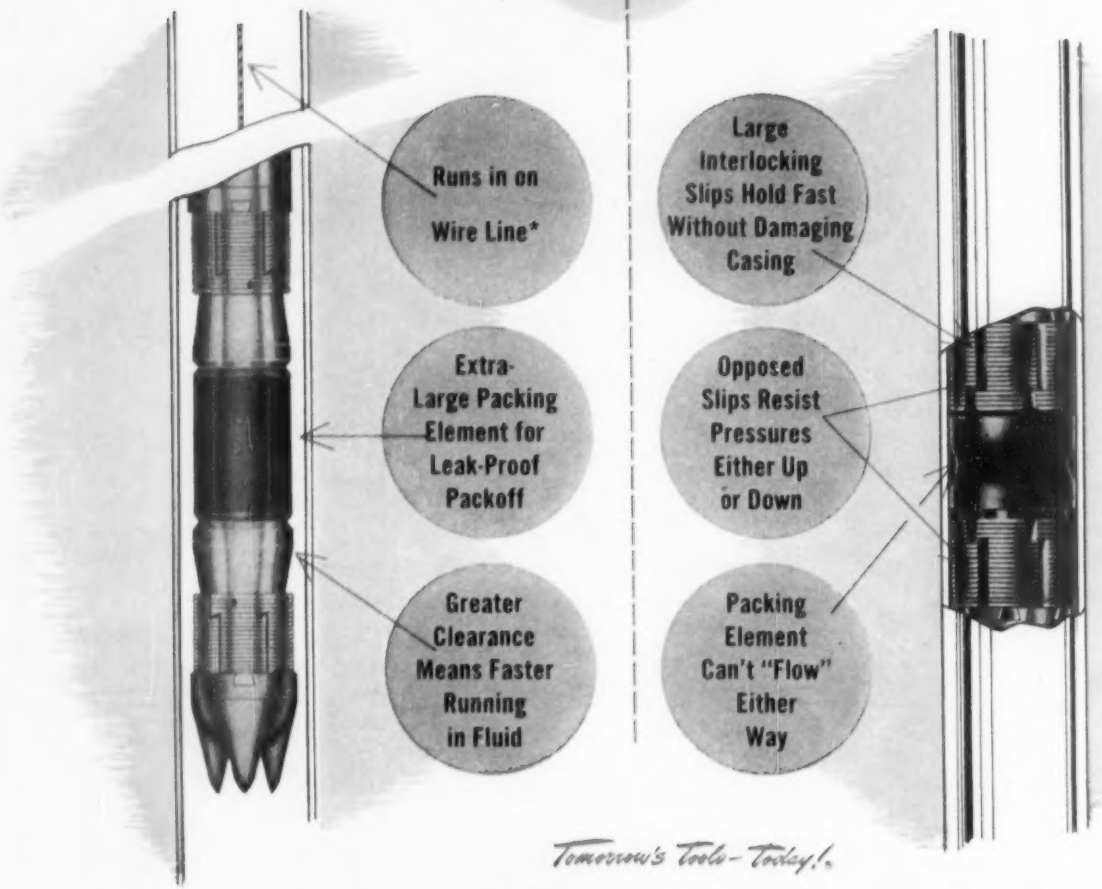
at the **operating advantages**

of these bridging plugs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TULSA, OKLAHOMA

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JOURNALLY SPEAKING . . .

$64,000 Question

THE whole TV-watching world is agog over the program known as "The $64,000 Question" on which contestants get a chance to double their prize money or risk losing it by taking on the next question.

Watchers are beside themselves with anxiety as the contestants try to decide whether to let well enough alone and quit the game with what they have or to go after more and possibly end up with nothing but a consolation prize. Several have been content to retire from the field with $32,000. Only one, a United States Marine officer, had the courage to go for—and get—the $64,000.

Advice pours in from all over the country, and it is overwhelmingly in favor of getting out while the getting is good. Why? Have Americans lost their sporting blood? Not that so much as that they are becoming aware of what the federal tax collector does to a big income.

Thousands of people have written or wired the contestants to warn that $64,000 isn't nearly twice as much as $32,000 now that Uncle Whiskers has dealt himself in on the multiplication table. They point out that the federal take on $32,000 is around $16,000 but on $64,000 it is nearly $39,000. So why risk losing a sure thing in the remaining $16,000 for a chance of getting less than $9,000, net, additional?

What does this have to do with the oil business? Simply this: If taxes make it unwise to risk money on a quiz program, don't they also make it unwise to risk money drilling oil wells?

If a man has the $64,000 it takes to drill a wildcat wouldn't he be smart to quit right there? If he gets a dry hole he'll lose it all (and won't even get the consolation prize the TV program gives its losers). But if he strikes a rich pool the Government will take away more than half of his earnings.

That's the $64,000 question in the oil business, and a lot of people are wondering how long investors are going to keep on taking this chance and thus keep the nation supplied with oil, particularly since wildcat wells miss oftener than TV quiz contestants do.

The only saving feature is the depletion allowance. This permits producers to deduct a percentage of their income before computing their taxes. This allowance—so far—has been enough to induce people to take the big risk in exploring for oil.

If the depletion allowance is taken away, and if taxes on big incomes aren't cut, not many people will care to take a chance on the $64,000 question in oil exploration. Maybe this TV program will help the oil industry convince the voters of that.

How to Be a President

HERE'S a success story that would make Horatio Alger turn over in his grave. A 9-year-old boy got to be president of Standard Oil Co. (Ind.). And all he had to do to get the job was express a wish for it. Sounds more like the Arabian Nights and Aladdin's Lamp, but strange and wonderful things happen in the oil industry in these days of modern public relations.

This Chicago kid had to write a school theme on what he wanted to be when he grew up. His classmates wanted to be cowboys, detectives, or ball players, but since his father runs a filling station he expressed the simple wish to be president of Standard. His qualifications: "I will try to make a lot of friends so I will be elected. It will take a lot of knowledge and that I have plenty of."

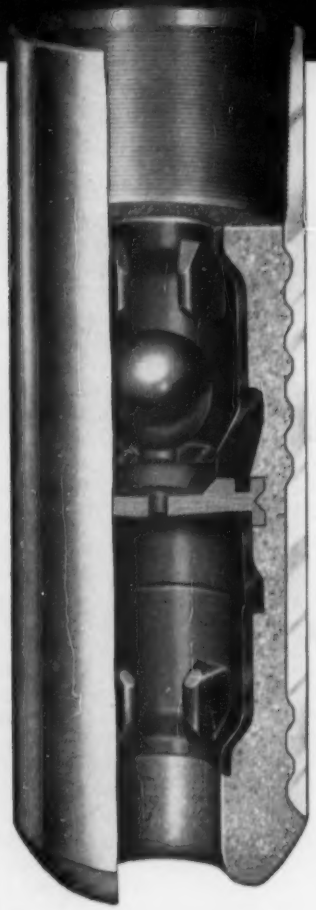
The teacher sent the essay to Standard's real president just for laughs. But lo and behold, early one morning this kid found his wish come true. He was given the title of president, sat in the president's chair, dictated a letter to his secretary, and criticized his predecessor for not looking like a president should. But only for 10 minutes, or just long enough for the newspaper photographers to snap some human-interest shots.

Warning: This is a stunt that will work only once. It won't do you any good to write to the president of this or any other oil company and say you'd like to have his job. It takes more than a wish to be the real president of a real oil company.

—*Henry D. Ralph.*

AUTOMATIC, REGULATED *FILL OF THE CASING AS IT IS BEING RUN*

***PROTECTION AGAINST DESTRUCTIVE HIGH-PRESSURE SURGES**



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BAKER FLEXIFLOW

FILL-UP SHOES AND COLLARS

Baker Flexiflow Fill-Up Equipment, a new companion line to Baker Differential Fill-Up Equipment is designed to be run in wells of moderate depth.

FEATURES

SELF-ADJUSTING FLOW CONTROL DIAPHRAGM

Baker Flexiflow Fill-Up Equipment contains a variable valve (Self-Adjusting Flow Control Diaphragm) that automatically opens wider or closes down to provide MINIMUM BOTTOM-HOLE PRESSURE INCREASES and regulated fill of the casing.

POSITIVE BALL-TYPE BACK-PRESSURE VALVE FOR CEMENTING

A Ball-Type, Back-Pressure Valve for floating or cementing can be brought into action at any time by applying a pressure of approximately 700 psi to the casing. See Figs. 2 and 3 below.

COMPLETELY DRILLABLE

The internal parts of Flexiflow Fill-Up Shoes and Collars consist of readily drillable concrete, a small amount of Bakelite and synthetic rubber.

ECONOMICAL

Baker Flexiflow Fill-Up Equipment not only permits the casing to be run more rapidly with greatly reduced pressure increases or surges on the formations below the shoe, but in addition, by eliminating the surface-filling operation, saves an additional amount of rig time. When these advantages are considered, Flexiflow Equipment is much more economical to run than conventional floating equipment.

*Pressure surges over 5,000 psi can be created each time a joint of casing equipped with conventional floating equipment is lowered under certain slim hole clearances.

High-Pressure surges can fracture and weaken a formation sufficiently to cause lost circulation or the failure of a primary cement job.

These destructive, high-pressure surges can be reduced . . .

- by increasing the lowering time per joint
- by increasing the casing clearance

or

- by running Baker Flexiflow (or Differential) Fill-Up Shoes and Collars

NOTE:

Baker Fill-Up Equipment contains a variable valve that automatically opens up and adjusts to maintain minimum bottom-hole pressure as the casing is being run.

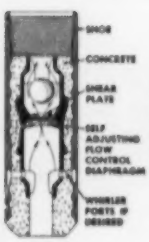

FIG. 1 Casing Filling while going in the hole

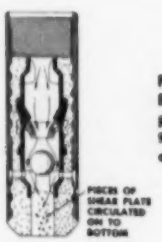

FIG. 2 Ball pumped through diaphragm

FIG. 3 Ball shut-off against cement back-pressure

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ODM's imports plan deserves a trial

ONLY time and trial will determine whether the new plan of the Office of Defense Mobilization to regulate imports will turn out to be a statesmanlike solution to this complex problem or will fail to do the job.

On its face, Director Flemming's letter to importers looks like a big step toward a satisfactory solution. But close analysis does not answer all the questions, nor reveal a specific forecast in terms of volumes, sources, and types of imports.

Taking the broad view that what may now look like fuzziness will be cleared up soon, the program has much to commend it. It confirms the recommendations of the Cabinet Committee on Energy Resources, is based on analysis of current facts and realities, and is the considered policy of the entire executive branch of the Government.

IT RELIES ON "VOLUNTARY" ACTION by importers. No matter how much backstage pressure may have to be put on importers to get the desired "voluntary" action, this is better than a formalized official quota system—for several reasons. It is more flexible, it has less danger of leading to federal control of the rest of the industry, it will have fewer diplomatic complications abroad.

The Government can't very well officially discriminate among foreign nations on imports. But the new plan sanctions preferred treatment for oil from the Western Hemisphere. This makes sense from the standpoint of national defense and is probably satisfactory to all but a very few U. S. oil operators.

What appears to be a realistic attitude is taken on heavy fuel oils. It is concluded that the current level of these imports is not injurious, and that the crux of the problem is crude oil—and a relatively small volume of crude from a few sources. This focuses the problem down to manageable proportions.

IN SHORT, THE FLEMMING LETTER appears to promise definite action, but the least amount of action that will achieve the objective. It looks like a skillful plan to do what the industry alone could not do without violating antitrust laws and what the Government alone could not do without violating international comity.

There is considerable of the pollyanna in the plan. ODM seems to have the view that rising domestic and foreign demand will remove the imports problem in the near future and that only short-term expedients are needed now. The whole industry can hope that this view is correct.

Until proved otherwise, we prefer the optimistic view of the program. At the least, the Government is trying to find a solution. If this particular plan develops defects, there is latitude to try another way so long as there is a will.

Shooting for Production

● A perforating gun entering the casing — familiar sight in the Oil Fields — is a reminder that, when you shoot for production, the properties and performance of the cement behind that casing are of key importance.

Lone Star shoots for production, too—for oil-field production — by engineering into its Oil Well Cements the properties required to assure strong, dense, long-lasting shut-offs under any given set of conditions.

Even before the quarry blast, raw materials are carefully prospected. Knowing their composition, the laboratory checks and adjusts all raw materials —and checks the finished product as well—to assure the required properties for each type of cement.

Let well conditions decide which cement to use . . . let trouble-free performance confirm your choice.

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The Industry This Week

Imports

• **The next move** will be up to the importers and the Government. In St. Louis, I.P.A.A. leaders voiced optimism over progress to date. They're adopting a wait-and-see attitude, but will renew their battle if neither company nor government action is forthcoming. P. 70.

Flemming discloses new policy. He is excluding Canada and Venezuela from consideration, but asking for a 7 per cent cut in crude imports from other countries. This would reduce crude imports about 25,000 bbl.—enough, Flemming thinks, to bring crude imports in line with the recommended level in 5 months. P. 71.

Refining

• **Look for atomic radiation** to make ever greater changes in refining. It's really an old, auxiliary tool which is moving into a basic role in oil processing. Some observers term the approaching changes the greatest thing in refining since catalysis. P. 66.

A new 25,000 to 30,000-bbl. refinery will be built on Tampa Bay near Tampa, Fla. E. Constantin, Jr., Dallas producer and financier, heads a group backing the venture. Large cracking capacity is planned. P. 72.

Pipelines

• **The FPC has canceled escape clauses** in contracts of independent natural-gas producers subject to federal regulation. The decision means these producers can abandon service only with FPC consent. P. 76.

Texas Eastern has completed laying its 377-mile, 30-in. natural-gas line from near Beaumont, Tex. to Kosciusko, Miss. P. 76.

Drilling

• **Richardson & Bass has only 179 ft. to go** for a world's deep-drilling record. The firm's test in the Mississippi delta marshes of southern Louisiana has reached 21,303 ft. It is now drilling ahead in broken shale and sand at a 20 to 40 ft. daily rate. Ohio Oil Co. holds the record of 21,482 ft. for a well in Paloma field of Kern County, Calif. P. 65.

Rising costs are threatening to slow up drilling activity. The I.P.A.A. cost-study committee warns that costs of equipment, materials, services and wages are up 10 per cent since June 1953. Cost of exploration and development work is up 13 per cent. Together they represent a 20 per cent increase for finding and developing reserves. Production is only 3.8 per cent higher while crude prices are the same. Only ways to keep drilling activity high are higher prices for crude or new methods of finding reserves. P. 79.

Production

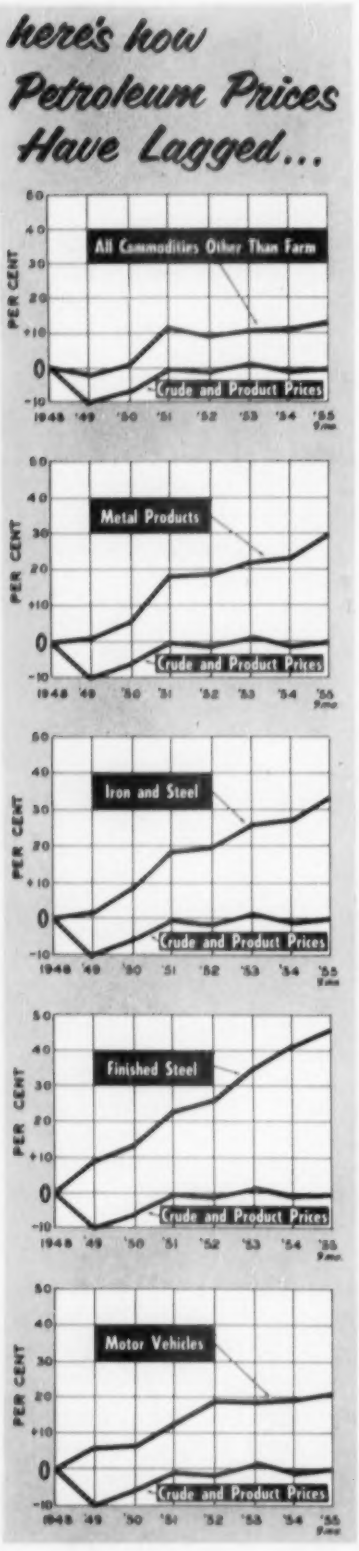
• **Colorado has its first unitization unit.** It is the 177-well, "J" sand reservoir of Adena field in Morgan County. Pure Oil will operate the project. It is expected to add 10,000,000 bbl. to ultimate recovery. Another 17,000,000 bbl. may come when secondary recovery is attempted. P. 82.

Economics

• **Total demand for crude will increase 3.4 per cent next year.** A forecast of 8,997,000 bbl. average daily use for 1956 was made by the supply and demand committee of the Independent Petroleum Association of America. The continuing gains were attributed to the nation's strong economic activity. P. 78.

Should the Industry Raise Its Prices?

- The question is getting some serious study, and it's cropping up more and more in oil men's conversations
- Nearly all agree it's justified by increasing costs, but they split over its effect on other industry problems



THE price of crude oil is too low. It doesn't cover the rising costs of finding and developing new petroleum reserves the nation must have for its future.

This is the opinion of a majority of oil men as expressed in informal conversations at meetings and other occasions in recent weeks. They point to many specific examples and a number of broad cost studies to bolster this opinion.

This has made the price of oil a topic of widespread and serious discussion throughout the industry today. Refiners and marketers as well as producers have joined the fray. But opinions are divided over the proper level of prices, when and how they might be raised—if at all.

Most operators feel the price of both crude oil and refined products will have to be raised sooner or later if costs continue to climb. Some think the time should be right now—or at least in the very near future. Others believe that full justification for a price increase will not develop for a year or more.

Industry men give many reasons why the price of oil should go up soon. Others also have many reasons why this is impossible or inadvisable. The arguments—pro and con—run like this:

Case for Higher Prices

The principal—the overwhelming—justification for higher priced crude is the cost of finding new oil. The magnitude of the industry's duty to provide new supplies staggers everyone in the business.

There are no dissents from the belief that new reserves remain to be discovered in this country. But finding them will take enormous outlays of capital. The cheap oil, the easy oil, has been found. New fields being found are, by and large, deeper. They're more elusive, smaller, than those brought in a few years ago. This means more investment in exploring and drilling per barrel of reserves added.

There is virtually unanimous agreement that the industry is selling its stock of goods for less than cost of replacements.

The exact cost of finding a new oil field is an elusive figure. It is difficult to prove by irrefutable statistics that the average cost of new reserves added in 1955 is a given number of cents per barrel above the current price of crude oil. But all studies of the subject leave little doubt. They show the present price will not long support an oil search at today's costs—especially on the scale required by the nation's economic and military needs.

New evidence . . . Most recent is this week's report by the Independent Petroleum Association of America.

It says the total cost of finding and developing crude oil in the United States is now approximately 20 per cent greater than in mid-1953 (details on page 79 of this issue).

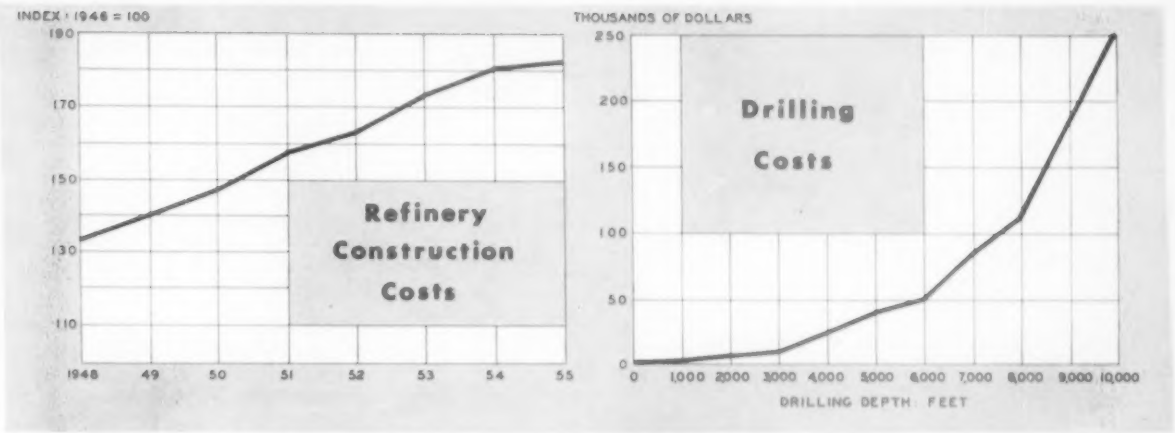
Another bit of evidence is a recent study by the Society of Exploration Geologists. It is summarized in a chart on page 63. In this chart, all new reserves discovered by geophysical methods are valued at $1 per barrel in the ground. This is believed a representative going rate for purchase of undeveloped reserves.

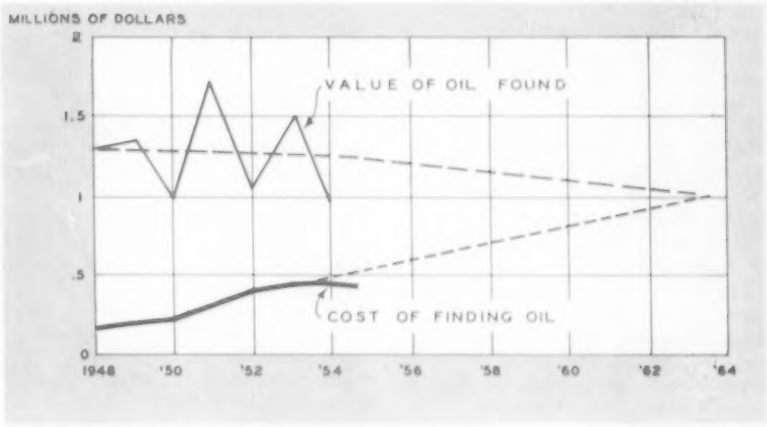
Below this is plotted the cost of the geophysical work done in discovering these reserves. Added to this is cost of leasing and drilling the first well—admittedly only a part of the cost of proving up a reserve. The trend lines projected on this graph indicate that in less than 10 years the cost of finding new oil by this method will equal value of the discoveries.

Early seismograph crews found over 14 million barrels of oil per crew year. Today with 650 crews looking for oil, the new reserves have dwindled to less than 2 million barrels of oil found per crew per year.

Twenty years ago a company could anticipate finding 30 million barrels of oil annually. It simply employed two seismic crews effectively the year round at an annual cost of less than half a million dollars. Today the same company must field 15 crews annually at a cost of about 3 million dollars to find the same amount of oil.

Paul Lyons in his presidential address to the S.E.G. pointed out that in 1954 geophysical costs totaled 50 cents per barrel of new oil found. The cost per seismic crew has not risen ap-





COST OF FINDING oil by geophysics is rising; value of oil so found is declining. Will the lines meet?

preciably over the years. But overall exploration costs have increased sevenfold in the past 20 years. Today the cost of finding new oil is about 20 per cent of the value of the oil in the ground. In the mid-thirties it was a mere 3 per cent.

No room for comfort . . . But new reserves are not being added in comfortable volume. The A.P.I. estimate of new reserves added during 1953 was so low it surprised the industry last spring. Those who have been following discovery trends since then expect next spring's report also will show disappointing additions to reserves. This is despite the vastly stepped-up exploration campaign. More money spent and less oil found mean just one thing: The cost per barrel found is skyrocketing.

Meanwhile, demand for petroleum products in this country—and all countries—keeps climbing steadily and inexorably. The gap between available oil and known needs is narrowing. It will take many millions of dollars to reverse this trend.

Drilling costs . . . New oil fields are hidden deeper in the earth's crust than most of those discovered a few years back.

This means more preliminary work before staking the wildcat. Greater risks hinge on a dry hole, since drilling costs are vastly higher. It costs not just twice as much to drill 2 miles as 1 mile, but several times as much. Costs go up geometrically as the drill bit goes down *(see accompanying chart)*.

Drilling a typical 5,000-ft. well today costs about $35,000, or $7 per foot. This includes only the drilling costs. Casing, tubing, completion, and other necessary equipment run this figure up to $50,000 or even $70,000. But drilling costs on a 10,000-ft. hole are in the neighborhood of $250,000, or $25 per foot.

Operating costs . . . have been going up sharply. No sign of a downturn is in prospect. Wage scales advanced last year—and may go up another notch next year. The price of steel was raised sharply last June. Another boost in steel prices is likely this winter.

These same factors require tremendously larger capital sums for expansion. Forecasts indicate the demand for petroleum products will continue to increase steadily. This means the industry must expand its capacity in all divisions. But each new plant facility costs more than the one before. This is illustrated by the accompanying chart on refinery construction costs. It is based on The Oil and Gas Journal-W. L. Nelson index of refinery construction costs.

Oil companies buy almost everything that goes into the nonfarm commodity price index—and that index is rising. Its biggest purchases are made of steel—millions of tons of steel. Last June the price of ingot steel went up 5.4 per cent. The prices of all oil equipment have been going up ever since.

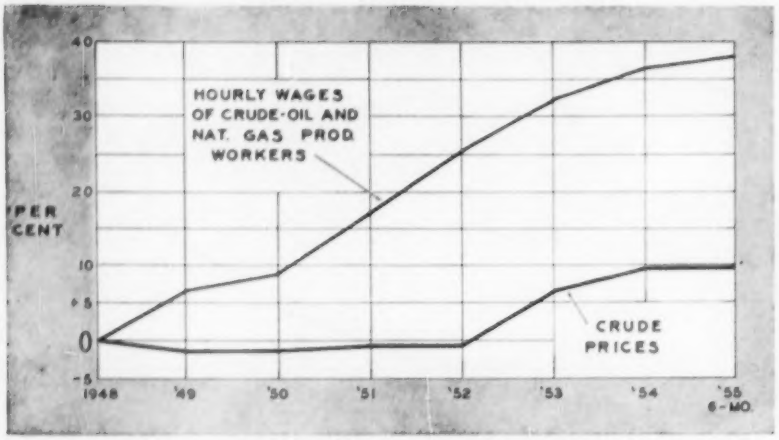
One medium-sized oil company found that the June price hike in steel will cost it $7,00,000 above its budgeted spending for equipment during the last half of 1955. This single example illustrates how oil is being squeezed between mounting costs and static crude prices.

In the last 10 years the average wages on a drilling rig have more than doubled. The price of tubular goods has jumped 7 per cent in the last 12 months. Casing priced in 1954 at $1.45 per foot now commands $1.55 per foot. Ten years ago the same casing sold for $.78 per foot. The same increases in general apply to the cost of most drilling and production equipment.

The Case Against

The common argument against a price increase now is the excess crude oil readily available to the United States market. The assumption is that prices can't go up until there is an actual shortage—or at least not until most of the surplus is worked off and the market begins to stiffen.

Around the industry's neck like a millstone hangs a reserve producing



capacity. It is variously estimated at from 600,000 to 2,000,000 bbl. per day and was built up at Government request for national defense. The economics of this situation makes it absurd to try for a higher price in the face of the laws of supply and demand. A higher crude price simply would stimulate faster production from known reserves. It wouldn't necessarily assure discovery of new reserves for future needs.

Imports would be stimulated by a higher United States price. This would make the current surplus even worse. The end result? The price would be forced down again soon, perhaps to a lower point than at present.

The products market . . . Higher-priced crude, of course, would mean higher prices for gasoline and other petroleum products. Refiners and marketers already operate on a slim margin and could not absorb more costs.

There are many difficult marketing spots throughout the country. Bitter price competition has forced refining and distribution margins in those areas down toward the vanishing point. In such places it would seem almost impossible to get products prices up to a level that would support higher crude prices.

A higher price for heating oil now would induce refiners to make more of this product. But stocks of distillate fuels are already on the high side. Unless the winter is unusually cold, there would be a surplus that could break the market. Residual fuels would lose much of their market to coal and natural gas unless the prices of these fuels should go up proportionately.

Public reaction . . . The consumer might not pay the higher products prices entailed in a crude-price adjustment. In any event, there would be a public outcry. It could destroy the industry's goodwill with bad reactions in Congress and state legislatures.

A higher price for oil now might kill any chance of enacting the pending Harris bill to remove natural-gas producers from federal regulation. It might prevent government action to restrain imports of foreign oil. It could trigger a lot of restrictive state laws.

Current earnings of many major oil companies suggest the industry is quite prosperous. This certainly would be used as an argument that higher oil prices are entirely unjustified. Quite likely there would be a congressional investigation of the price increase. It would come at a time when the industry most needs the sympathetic understanding of Congress and the public.

Some Answers

Not all men in the oil industry consider these obstacles valid or insuperable. Among the rebuttal arguments are these:

Defense reserve . . . Excess producing and refining capacity was created at Government request. The industry should be compensated for carrying the burden by getting a higher price for produced and refined crude. Market-demand proration could keep defense reserves of crude in the ground. That would prevent it from flooding the market. Producers thus would be more content with their present low allowables if a higher price brought them more income per well.

Products markets . . . Consumers would support higher prices for products. The demand for oil is growing and prices of almost everything else are going up in the present inflationary spiral. Stocks of refined products are not excessive when compared with the current rate of consumption.

If prices of crude and products go up together, the competitive situation remains exactly where it is now. But a higher level has been achieved. Problems of margins and competitive marketing would neither be worsened nor improved.

The oil industry should not be ruled by "thinking in margins"—by the psychology that a slim profit margin in one of its operations prevents any effort to put its other operations on a sound basis. If refining and marketing are yielding inadequate returns, all the more reason to avoid losing money in production.

Imports . . . Imports are a problem and a threat to the price structure in any period of ample supply. But they would not necessarily be increased if our entire crude-price structure were upped a bit.

Even if the Government fails in its present efforts to work out a satisfactory plan to regulate imports, it may be assumed that foreign producing costs are on the upgrade also. And the big importers—all of whom have domestic production—might be encouraged to look for new reserves here instead of abroad if our price is put in line with costs.

Public reaction . . . If the industry has a good case for higher prices, it should act on it. It should defend it before the bar of public opinion and congressional committees. The cost of finding new reserves for future use really has no bearing on federal regulation of natural gas, dealers' margins, or other industry matters.

The oil industry is not a public utility. It does not have to get advance approval of any governmental agency before changing its prices. The growing idea that oil can't act of its own accord should be scotched.

Currently good earnings of many companies are deceptive. They do not reflect the true condition of the industry as a whole, do not reveal that the industry is liquidating its assets of crude reserves at less than the cost of obtaining new ones.

Other industries have had the courage to raise their prices when demand is good, when their costs are rising, when they need capital for expansion. Steel and autos are examples. Last summer when steel wages were raised, the steel companies did not hesitate to raise their prices. Now the steel industry is saying that still higher prices may be quoted soon to obtain capital needed for expanding ingot capacity.

Thus run the arguments, pro and con. The amount of informal discussion now going on in the industry indicates the serious thought given to the price of oil and its long-range effects on petroleum operations. It's a lively topic. It's one not likely to be dropped whether or not any action is taken.

Wilson looks ahead and finds . . .

. . . Atom Will Rescue Oil

ST. LOUIS.—The impact of atomic energy on the oil industry is far in the future.

It will be negligible over the next 20 or 25 years. When the atom finally is harnessed for civilian work, oil will be so hard pressed to fill the nation's energy demand that atomic energy will be welcomed.

"The country's needs for energy are expanding so rapidly . . . that the ultimate problem is not what fuel is going to be crowed out, but what can come along to help carry the growing load."

This is what Robert E. Wilson, chairman of the board of Standard Oil Co. (Ind.), told the Independent Petroleum Association of America at its annual meeting here last week.

First area of competition will be power plants, but it will be 10 to 25 years before truly commercial units will be using atomic fuel in a considerable amount.

"Heavy residual fuel oil would be almost the only oil product affected, as it is the only one in substantial use by central power plants," Wilson said.

"Even if we lost all our central power plant business during the next 25 years, we would hardy notice it; in fact, we may well lose most of it to coal before that, and no tears would be shed."

Power plants take only 10 to 15 per cent of the residual sold, Wilson said, and this represents only 3 per cent of crude runs.

For other markets, Wilson had this to say:

. . . **Fuel for ships:** Ships now take about 20 per cent of our residual. The high first cost of atomic-power ships will delay their commercial use even longer than power plants.

"If we should lose the fuel-oil business of some of the larger new ships after 15 or 20 years, what of it?"

. . . **Land transport:** The only use of atomic power now seriously discussed is in locomotives. "Even if it were safe and economical, which I seriously doubt, can you imagine either the railroads or regulatory authorities being willing to risk a possible wreck of an atomic engine in one of our large cities?"

For cars, trucks, or buses, the idea is fantastic. The same is true for passenger planes.

. . . **Space heating:** Atomic heating in homes or apartment houses is ruled out by the need for heavy shielding, the problem of handling wastes, and the high cost.

. . . **Natural gas:** While the use of gas for power generation has been increasing, it still accounts for less than 20 per cent of the country's total fuel for electric power.

It is used largely because it is available as "dump" gas at low prices during the warmer seasons.

Availability of dump gas will drop as older contracts expire and as more underground storage is acquired near consuming centers. The use of gas in power plants outside the gas areas will drop gradually whether or not atomic energy begins to compete.

What's ahead . . . The long-range trend of petroleum costs and prices is upward and likely to continue that way, Wilson said.

Atomic-power costs, however, are headed the other way and should continue downward for at least the next two decades.

For central power plants, the two curves seem likely to cross sometime within the second decade from now. For most other uses, the crossing will be far in the future, Wilson said.

Oil's present price advantage is so big that only a "very major increase in price," Wilson said, could prevent it from "having all the business it will be able to handle far beyond the next 25 years."

Help from the atom . . . Atomic energy is likely to help the oil industry in many direct and indirect ways, Wilson said.

The threat of bombing has encouraged decentralization. And this means more travel, powered by oil, over roads built largely with asphalt.

The atom bomb means fewer bombing runs by planes. This means a fuel saving, therefore less rationing and a lower peak war load for the oil industry.

Isotopes, Wilson said, hold tremendous promise for the refining and other divisions of industry. (See page 66).

Gasoline Plant Planned

ABILENE, Tex.—Thomas C. Shaw, of Abilene, heads a group of producers who will build a $3 million, 25,000,000 cu. ft. natural-gasoline plant in Nolan County, Texas.

Petroleum Constructors, of Los Angeles, has the contract and expects to have the plant on stream within 7 months. Holder Construction Co., of Snyder, Tex., will lay the gathering lines.

The liquids will be shipped through Magnolia Pipe Line Co. The dry gas will be taken by Lone Star Gas Co. and El Paso Natural Gas Co.

With only 179 ft. to go . . .

. . . Test Nears Drilling Record

NEW ORLEANS.—Richardson & Bass was only 179 ft. from the world's deep drilling mark last week.

The 1 LL&E-Humble-"L" had reached 21,303 ft. It is drilling ahead in broken shale and sand. The deep wildcat, 35 miles southeast of here in the Mississippi delta marshes, has been averaging 20 to 40 ft. a day. That means it may become the world's deepest hole this week if it can avoid trouble.

The big barge-mounted steam rig had a good day during the 24 hours ending at 8 a.m. November 2, making 54 ft. of hole. The day before it made only 14 ft., however, due to time lost making a round trip.

The deep test already is the second deepest ever drilled, displacing in September Superior Oil Co.'s 1 Unit which went to 20,521 ft. in 1949 in Sublette County, Wyoming. It also has broken by 2,643 ft. the Louisiana depth record formerly held at 18,660 ft. by a Magnolia Petroleum Co. wildcat drilled in Allen Parish in 1952.

The endangered "world's deepest" record was set by Ohio Oil Co. at 21,482 ft. with its 72-4 Kern County Land Co.-A in Paloma field of Kern County, California. Another threatened record is that of the world's deepest production. Richardson & Bass reported in mid-October potential pay zones which, if found commercial, would give the well by far the deepest production.

California also holds this mark. Richfield Oil Corp. completed a well in December 1953 in North Coles Levee field near Bakersfield for gas condensate production from 17,500-895 ft.

Associated with Richardson & Bass in the south Louisiana project are John W. Mecom of Houston and Freeport Sulphur Co., New Orleans.

Refining Revolution Riding On Atom

- **Atomic radiation soon may move into a basic role in oil processing; it's really an old tool with a new outlook**
- **Some observers call approaching changes greatest thing in refining since catalysis; millions going to research**

George Weber

NEW YORK.—Atomic radiation may cause the greatest revolution in petroleum refining since advent of catalysis.

This rather grand outlook, previously hinted at, is now gaining more support from petroleum research leaders throughout the industry. Management also seems convinced there is something to it. Witness the millions of dollars dedicated to new radiation laboratories within the past year.

Old tool . . . Oil industry use of radioactive isotopes is not new. These valuable by-products of the nation's atomic energy program have long found application as tools or aids in various phases of research and operation.

As tracers, many isotopes perform routine duties in production, pipeline, and refining operations. They add a new dimension to research into complex hydrocarbon reactions. They have extended analytical work to new limits of accuracy.

Measurement of radiation from high-activity sources has given rise to a new technique. It can determine liquid and solid levels in closed vessels, density, and carbon-hydrogen ratios of materials, and make nondestructive inspection of equipment.

New concept . . . But the new concept of nuclear radiation is more fundamental. It takes this new source of energy out of the category of an auxiliary tool. It proposes to give it a basic position in processing petroleum products. This new look at atomic energy also goes beyond the straight use of isotopes. It will use particle accelerators. They provide added flexibility and power by accelerating and concentrating the flow of atomic particles from radioactive sources *(The Oil and Gas Journal, October 31, page 48).*

Possibility Startling

Some very profound developments are expected from this booming radiation research program in oil. From the cautious comments now made, it appears that nuclear energy may well find future application across the board in refining procedures.

ISOTOPE PROJECTS IN REFINING

	No. projects (to 10-12-55)
Refining Research:	
Catalysts and catalytic reactions	91
Density and carbon-hydrogen ratio measurements, corrosion, basic and miscellaneous	24
Laboratory and pilot plant studies of refining processes	23
Activation analysis and product studies	14
Combustion research	12
Refinery Operation:	
Catalyst circulation and density measurement	22
Liquid, coke and catalyst level measurement	15
Liquid flow and leakage studies	10
Process unit evaluations	8
Entrainment and stripping studies	6
Product Evaluation:	
Engine wear studies with irradiated piston rings	61
Wear studies, other engine parts, bearings, tools, etc.	41
Evaluation of combustion products and deposits	15
Corrosion evaluations	2

Radioactive isotopes may be combined with conventional techniques involving heat, pressure, and catalysis to set off hydrocarbon reactions impossible or impractical today. As a result, studies are underway to determine how this form of energy can affect catalytic and thermal cracking, hydrocracking, isomerization, hydrogenation, dehydrogenation, polymerization, alkylation and reforming.

Selective processing . . . The trick here seems to be finding a way to alter carbon linkage by hitting the outer orbit of the carbon atom. The advantage lies in ability to perform this alteration specifically in order to bring the exact reactions desired.

This new degree of selectivity in petroleum conversion is no dream. Cross-linkage of long-chain molecules has already been accomplished. Further investigation should uncover new ways to bring about tailor-made reactions. These may one day replace the "shotgun" approach to conversion by means of heat and catalysts alone.

New look at lubes . . . There also exists a strong possibility that irradiation of finished products may find an important commercial application. One such prospect lies in irradiation of lubricating oils. Although still under wraps, this work is understood to have advanced far enough today to justify high optimism.

Actual procedures are not known publicly. But they are understood to result in higher viscosity indices, greater stability, and improvement in other lube-oil characteristics. If this is true, it may signal a reversal in the current trend away from petroleum-based lubricants for modern high severity conditions imposed by jet engines, gas turbines, and other power units.

This irradiation of lubricating oils is said to involve some changes other than cross-linkage of the long-chain molecules. But this well-known radiation effect has been demonstrated in treating such materials as polyethylene and petroleum waxes. Subjection to nuclear radiation results in increasing molecular weights and raising melting points substantially. Moreover, the operation permits a degree of control whereby varying amounts of radiation bring about specific results.

Two Views on Radiation

In studying the possibilities of radiation processing, oil companies are taking two general routes.

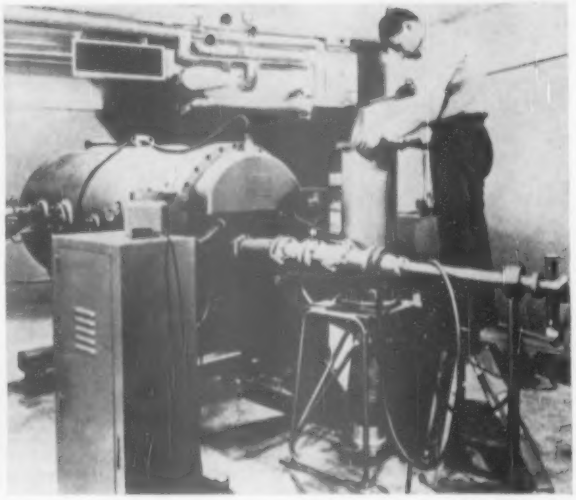
One utilizes radioactive isotopes which show high activity, such as cobalt 60 as well as fission-waste radioisotopes. These materials give off beta particles which are high-speed electrons. They also emit what is called gamma radiation, a nonmaterial short-wave radiation of the same general nature as X-rays and ordinary light.

The other route to radiation studies employs the Van de Graaff particle accelerator. This device is in effect an electron gun. It speeds up and focuses electrons and other atomic particles by means of magnetic coils, to velocities up to 600,000 million miles per hour. This provides a higher energy source than presently used isotopes, for bombardment of a petroleum sample. The energy level can be adjusted, and when the gun is turned off, all radiation ceases.

Many oil company research centers have been using secondary radioisotopes for radiation studies. These are elements which have been made radioactive by exposure to radiation in atomic piles.

Isotopes . . . Prominent among the users of radioisotopes as radiation sources is Esso Research & Engineering Co.

This summer, the affiliate of Standard Oil Co. (N.J.) installed a length



TWO RADIATION sources for oil industry research: At left, Esso Research's set-up for remote manipulation of cobalt 60, a highly radioactive isotope. Right, Shell Development's particle accelerator or electron gun.

of 3,500-curie cobalt 60 pipe in the new radiation laboratory at Linden, N. J. This is far the "hottest" radioisotope shipment ever made to an oil company.

But higher activity sources are on the way. Last week, Sinclair Research Laboratories announced plans for a radiation laboratory at Harvey, Ill. It will utilize uranium fission products with activity up to 100,000 curies.

Socony Mobil Research Laboratories will also use fission isotopes. It will go a step further by participating in a joint project for building the first privately owned nuclear reactor for research use. This installation will be built somewhere in the New York area and will provide the company with an extremely high source of radiation activity. In addition, the company will build a separate radiation laboratory which will use fission products from the joint atomic pile.

Accelerators . . . The oil industry has proved to be a major customer for the Van de Graaff particle accelerator.

The first use of this device was made in 1953 by Magnolia Petroleum Co. at its field laboratory in Dallas. The 0.5 million electron volt machine is used in well logging studies.

Three other Van de Graaff accelerators are now in use in petroleum labs. Shell Development Co. installed a 2 m.e.v. unit in its Houston laboratories in 1954. Humble Oil & Refining Co. has a 2 m.e.v. unit, also in Houston. Last spring, Atlantic Refining Co.'s research and development laboratory received a 1 m.e.v. unit at Philadelphia. It may eventually be raised as high as 10 m.e.v.

On order are a 3 m.e.v. Van de Graaff accelerator for Shell Development's Emeryville, Calif., laboratories, a unit of equal output for Gulf Oil Corp. at Harmerville, Pa., and a 2 m.e.v. accelerator which Socony Mobil will install in its new radiation laboratory in the East.

What Has Been Done

Spectacular as this new research concept may be, it still lies in the realm of promised developments. Accomplished benefits from the use of isotopes from the Atomic Energy Commission are so frequent they have become almost routine. Moreover, these current uses have gone far beyond the "gadget" phase.

The use of both stable and radioactive isotopes in manufacturing can be roughly classified three ways. Predominant is the research application. Many techniques developed in the laboratories have found application in refineries, where they fall under the operating category. A third use is evaluation of finished petroleum products. A rough breakdown of these applications is shown in the accompanying table.

Research applications . . . In specific refining problems, isotopes have found widespread use in research.

It is impossible to outline them individually in a limited report. Practically every petroleum research laboratory in the country is involved in isotope work. A count of AEC authorized licenses to use isotopes shows that over 160 different projects can be definitely classified under refining research. These include only those projects on which specific information is available. For confidential application, oil companies have been issued over 200 licenses to use isotopes. Many of these undoubtedly concern refining research and their confidential nature implies important new developments which can only be guessed at.

Catalysis . . . Much of the known isotope work in refining research involves the study of catalysts and catalytic reactions. This covers a broad field. Through the use of such tracers as carbon 14, deuterium, tritium, and other isotopes, new light is being shed on the mechanism of catalytic conversion.

Catalysts themselves are under intensive study. Researchers want to know the character of catalyst surfaces. They are evaluating the gamma irradiation effects on catalyst porosity. And also they are studying the activity, selectivity, and measurement of carbon, hydrocarbon and metallic deposits on catalysts.

The effect of certain contaminating metals on catalyst activity is well known. Through the use of radioisotopes of arsenic, sulfur, iron and other metals, contamination on the order of a few parts per billion can be measured, along with its effect on activity.

Activation analysis . . . A common method for gaining new accuracy in

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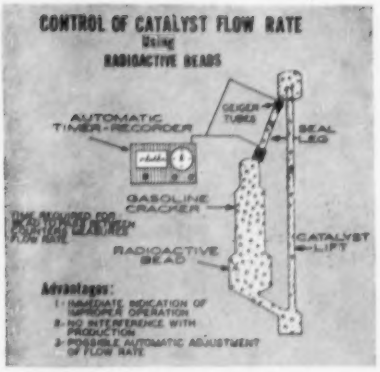
Next Week:

Atoms in the Field

Will atomic radiation help find more oil, produce and transport it?

The vital questions will be discussed next week in the Journal's final article in a series on use of isotopes in the oil industry. This article will cover use of radioactivity in exploration, drilling, production and pipelining.



—"Isotopes . . . An Eight-Year Summary of U. S. Distribution and Utilization," U. S. Atomic Energy Commission, 1955.

measuring catalyst deposits is activation analysis.

This service is offered by the Isotopes Division of AEC. It permits companies to send commercial catalyst of feed stock samples to AEC installations. There they are subjected to irradiation in atomic piles. The contaminants present in the samples become radioactive, and a study of their type and degree of radiation permits a highly accurate evaluation of what is present and in what quantity.

This type of analysis goes far beyond the limits of accuracy possible with chemical analysis. It also has an advantage of not having to handle radioactive materials in laboratory or commercial units. This service, originally limited to research, is now finding increased use in evaluating commercial operations. It can be said to have evolved into a useful tool in refineries proper.

Tracer work . . . Radioactive tracers laid down on fluid catalysts have been used in studying circulation and mixing rates in fluidized beds. Loss rate and over-all turnover rate studies also have been improved by the same procedure.

Analysis of trace materials in feed stocks by activation analysis is another widely spreading practice. This finds use in determining best practices for feed stock segregation and blending, and in projecting results to be obtained from catalytic conversion of various crude fractions.

A valuable aspect of isotope work lies in the new ability to obtain rapid and continuous analysis of hydrocarbon streams in research units. Degree of sulfur removal in hydrogen treating, and carbon-hydrogen ratios are two good applications.

Much use can be made of radioisotopes in other than conversion work. Separation systems can be checked for efficiency. Tracers also aid in volatility studies. Carbon 14 and cobalt 60 are used in determining the rate of settling and diffusion of water in oil fractions. Heating oil stability and the corrosive action of organic acids are being studied through the use of tritium and iron 55. Film thickness determination has been vastly improved through measuring absorbed or reflected radiation. Very thin oil films can now be studied with great accuracy in lubrication and surface wetting research.

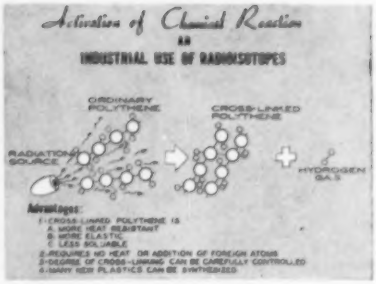
Underlying all of these diverse uses of isotopes are the long-range projects aimed at increasing the efficiency and uses of all the conventional refining processes. These studies aim to upgrade products by methods now in use. Beyond this type of investigation lies a basic work: finding out how direct radiation will affect these and other prospective commercial processes.

Isotopes in the plant . . . Commercial devices containing radioactive materials, commonly cobalt 60, are now in routine refinery use. They inspect welds, wall thickness measurements and do liquid level gaging in closed vessels, tanks and tank cars.

Several refineries also are using similar devices to measure the level of coke in drums and the level of the dense beds in fluid catalytic reactors and regenerators. Smaller, less powerful radiation sources are increasingly used as troubleshooters. They find plugs in fluid catalyst lines. Metal inspection, classified as radiography, is widespread today. This type of isotope use is not included in the breakdown shown in the table referred to previously.

REFINERS USING ISOTOPES

American Oil Co. (Texas)
Atlantic Refining Co.
California Research Corp.
Cities Service Oil Co.
Continental Oil Co.
E. I. du Pont de Nemours & Co.
Esso Research & Engineering Co.
Esso Standard Oil Co.
Ethyl Corp.
General Petroleum Corp.
Gulf Research & Development Co.
Houdry Process Corp.
Humble Oil & Refining Co.
M. W. Kellogg Co.
Pan-Am Southern Corp.
Phillips Petroleum Co.
Pure Oil Co.
Salt Lake Refining Co.
Shell Development Co.
Shell Oil Co.
Sinclair Refining Co.
Sinclair Research Laboratories
Socony Mobil Laboratories
Socony Mobil Oil Co.
Standard Oil Co. of California
Standard Oil Co. (Ind.)
Standard Oil Co. of Texas
Sun Oil Co.
Texaco Development Corp.
The Texas Co.
Tide Water Associated Oil Co.
Union Oil Co. of California
Universal Oil Products Co.



—"Isotopes . . . An Eight-Year Summary of U. S. Distribution and Utilization," U. S. Atomic Energy Commission, 1955.

Entrainment studies in commercial units are greatly aided through the use of such tracer materials as carbon 14, sodium 24, antimony 124, calcium 45, rubidium 86, and strontium 90. This entrainment work involves studies in fractional distillation, vacuum flashing, asphalt stripping and settling operations.

Also common in some refineries is the use of zirconium 95, nickel 95 and lanthanum 140 to measure catalyst-flow rates. Other tracers such as iodine 131 and antimony 124 are used to find leaks in refinery pipe lines and manifolds. They study the mixing of stocks and products in lines. By means of oil soluble compounds of rubidium 86 and iodine 132, some operators are testing the mixing efficiencies of alkylation reactors and grease vessels.

By means of the tracer-dilution method, accurate measurements of waste-water volume can be determined. This method calls for injection of a very small measured amount of a water-soluble isotope into waste streams. The degree of radiation at various down-stream points gives a direct reading on volume. This dilution technique is reliable and safe. It involves minute quantities of radioisotopes which decay rapidly.

These represent projects which are already under way in refineries. There remain many additional applications which are now only in the planning stages. For example, minute amounts of isotopes may be injected into the interface when switching charge stocks to a unit. This will allow operators to follow the interface through the unit and select proper cutting points for products. This procedure is similar to that used in product pipelines.

Entrainment of heavy ends in vacuum units often poses a problem in getting a maximum yield of catalytic feed stocks from reduced crude. The degree of metal contamination is the critical factor. Activation analysis of vacuum overhead stream samples will

help find the optimum balance on yield and contamination.

Activation analysis should also prove useful in detecting and locating refinery waste seepage and leakage. It is not always advisable to add isotopes to these streams if they could conceivably wind up in plant effluent streams. A study of irradiated samples will give an anlysis of the components. Thus leakage of contaminants can be measured and located.

Evaluating products . . . The use of irradiated piston rings has so greatly expedited engine wear tests that many laboratories now use this method on a routine basis. It is possible to obtain accurate, reproducible wear results in a matter of hours where weeks or months formerly were required.

This idea has spread to the wear study of other engine parts. They include valve lifters, gears, cylinders and cylinder sleeves and cam followers, which are made radioactive by service irradiation. Similar wear studies are made on cutting tools to evaluate cutting oils. Bearing tests using phosphorus 32 and injector plunger wear tests with chromium 51 have been used to test lubricants. Soaps and greases have been tested in wear studies employing calcium 45.

Sulfur 35 has been used to study the effect of lube additives and detergents on engine wear and deposit formation. In some cases, lubricating oils are tagged with carbon 14 to trace the formation of deposits attributable to lubricants alone.

Radiator leakage and crankcase dilution can be detected using isotopes. Other studies have used sulfur 35 to check on varnish and engine sludge formation.

What of Future?

Valuable nuclear tools are finding wider everyday use in refineries. This stems from a growing awareness of the versatility of radioisotopes. It is coupled with a greater confidence in their safe handling.

Judging from the rising usage curve, these byproducts of the atomic energy program should become commonplace in research labs and refining plants across the nation.

A much wider front will be opened if basic studies using radiation as a process medium produce expected results. This will make the refining industry one of the AEC's major customers for stable and radioactice isotopes.

"Cost-imating" Series

The Journal's new series on "Cost-imating" starts in this issue. The first article, "Construction Steel Price Trends," is on page 127.

The series is being prepared by W. L. Nelson, the Journal's technical editor. Look for the paginated feature "Cost-imating" every other week. On alternate weeks, the paginated feature will be Nelson's "Answers to Technical Questions."

Midland Operator Takes Over I.P.A.A. Reins

Robert L. Wood, Midland, Tex., independent and owner of Basin Drilling Co., last week was elected president of the Independent Petroleum Association of America. Wood, at left, succeeds William M. Vaughey, Jackson, Miss., at right. W. L. Kistler, Jr., Tulsa, president of W. S. Kistler, Inc., was named treasurer at the association's annual meeting in St. Louis.

Industry Briefs

DENVER. — Unitization has been proposed for the entire Rangely field, Colorado's most prolific producer, located in Rio Blanco County. It will be considered November 21 at a hearing before the Colorado Oil and Gas Conservation Commission. The commission also will decide whether to make permanent an order fixing the top oil allowable in the field's Weber reservoir at 300 bbl. daily. Natural-gas production was not restricted at the last meeting. Operators indicated they will continue injection to prevent waste until permanent production rules are adopted.

SILSBEE, Tex.—Sinclair Oil & Gas Co. has put a new gasoline plant on stream near here. It is designed to process 20,000,000 cu. ft. daily of gas and distillate from the South Hampton reservoir in Hardin County. It is owned jointly by Sinclair and several other operators. Contractor was Disen Co., Houston.

CHICAGO.—Tekoil Corp. has purchased for more than $1 million all the oil and gas properties of Kio Oil & Development Co. in Illinois, Indiana, Kentucky, and Texas. Tekoil said the purchase increased its proven primary reserves by more than 500,000 bbl. and proven secondary reserves by more than 1,500,000 bbl. The deal is subject to approval by Kio stockholders.

DENVER. — Black Thunder Oil-Uranium, Inc., Rapid City, S. D. has merged into Mountain Valley Oil Corp., Denver. Its stockholders received one share of Mountain Valley stock for each 30 shares of Black Thunder. Mountain Valley acquired Black Thunder's gasoline plant near Newcastle, Wyo., an interest in two producing oil wells, and the surrounding 240-acre lease in Weston County, Wyo.

ODESSA, Tex.—T. C. Huddle and G. L. Ohrstrom of San Antonio have sold 13 San Andres lime producers in South Cowden and Foster fields of West Texas. Earle B. Mayfield, Jr., Dallas attorney, is the buyer. Sale price was reported at $400,000. The wells are on a 490-acre block.

DENVER. — Purchase of Sure Oil Co. for $400,000 was announced last week by General Resources, Ltd., Denver oil-uranium firm. General Resources acquired 14 producing oil wells in Nebraska, Wyoming, and Colorado, as well as sizable lease holdings in Colorado's Julesburg basin.

DR. A. S. FLEMMING
"... We will face up to the facts."

P. C. SPENCER
"... Compromise and mutual sacrifice."

W. M. VAUGHEY
"... Further progress and a final solution."

The Fight Over Imports Hits a Lull

- Leaders of I.P.A.A. see optimism in actions of the past year, think a final solution is now in sight
- Spencer urges industry action; Flemming warns against government control; Vaughey predicts further progress

Ted A. Armstrong

ST. LOUIS. — The oil industry last week hit a lull in its long and bitter battle over imports.

There were indications the fight might have passed its climax. The next moves were up to the importers and the Government. Those who have fought higher imports sat back to see what would happen.

There were these developments:

... **Dr. Arthur S. Flemming,** director of the Office of Defense Mobilization, hinted strongly that importers will be forced into line with the Cabinet-recommended level if they don't cut back voluntarily.

... **W. M. Vaughey**, retiring president of the Independent Petroleum Association of America, told his members he was "confident" of "further progress and a final solution in the best interests of all."

... **The I.P.A.A. policy committee** on imports described Flemming's letter to importers (see opposite page) as "further encouragement that a solution ... is not only in process but will be forthcoming."

... **P. C. Spencer,** president of Sinclair Oil Corp. and chairman of the American Petroleum Institute, urged all segments of industry to prepare to make some sacrifices, to not press too far "for our own interests," and to place the security and welfare of the United States above all other considerations.

... **Russell B. Brown,** general counsel of I.P.A.A. and long a leader in the fight against high imports, told the association the problem "is moving definitely in the direction of solution."

Not since the first storm of protest broke over the rising rate of imports had there been such optimism among importers, independents, and Government.

Though the imports tune was being sung in a new—and sweeter—key, no one was certain yet that the long battle was over. The independents, most vocal opponents of high imports, were taking an optimistic attitude, but saying in effect: "Let's see what happens now."

What Flemming said ... Flemming told the I.P.A.A. his memo to importers was no "personal" letter.

"It represents a unified, united approach" to the problem by the executive branch of Government, he said.

When the new information he is requesting is in, he declared, "We will face up to the facts."

"I still hope it will not be necessary for Government to intervene in a formal manner. If Government does step in, it may be a long road with many complications."

Flemming told a press conference the 7 per cent cut he asked importers to make in oil from countries other than Canada and Venezuela would "make room" for the "new" importers.

If such a cut is made, he said, imports then will be in line with the Cabinet committee recommendation.

He praised "certain importing companies" for "commendable efforts" and lauded the Venezuelan Government for encouraging producers there to reduce their shipments to the United States.

He wouldn't say specifically what the Government would do if one or more companies failed to comply with the nation's new oil policy. But he made it clear that the Government would lay down an over-all policy which would guarantee the security of the domestic industry.

The committee report ... The I.P.A.A.'s policy committee wrote its report before Flemming's talk.

In it the committee urged "prompt and effective action" to cut imports. Because of ODM's actions to date, the committee said, it was "confident" that action will be taken.

After Flemming's talk, the committee met again and added this sentence:

"The recent letter to the importing companies from the director of defense mobilization, announced on October 31, gives further encouragement that a so-

lution to the problem of excessive imports is not only in process but will be forthcoming."

The report cited three requisites to a solution of the imports problem:

. . . **Treat imports** on a national basis to maintain an over-all relationship between them and domestic production.

. . . **Set specific standards** for measuring the proper level of imports. "The exact level is less important than the determination and the maintenance of a definite and assured relationship," the report said.

. . . **Existing importers** must "move over" to make room for (1) imports from new foreign sources; (2) imports by new importing companies; and (3) sales of foreign oil for importation by other companies.

Spencer's statement . . . Spencer urged the oil industry to solve the imports problem by "compromise and mutual sacrifice."

The industry, he said, should "stick together, settle our own affairs, and don't bring Government into the picture."

The imports problem, he warned, involves the security and welfare of the United States. "Individual interests must give way to that consideration."

"I know from the reports that come to me on my own company's operations," Spencer told the I.P.A.A. meeting, "that our cost problems would be helped by the use of more imported crude oil.

"But we realize that we cannot go beyond a reasonable point, that we must sacrifice some higher profit margins for the sake of domestic production . . ."

Spencer warned strongly against seeking government action. "Government doesn't get into something in a small way. It is usually whole hog or none . . . There cannot long be such a thing as 'a little government control.' The same thing that happened in the gas industry can also happen in the oil industry."

What Vaughey said . . . For 20 years, Vaughey told the I.P.A.A., Government has encouraged imports of most commodities.

"In view of these circumstances, I sincerely believe that developments during the past year are cause for real encouragement.

"For the first time in more than 20 years, both Congress and the executive branch of Government have taken action directed toward establishing a proper balance between oil imports and U. S. production."

Vaughey cautioned the independents they must "continue to recognize that foreign oil is an important factor in the nation's trade program and in the strength and stability of the free world.

"In turn, we have a right to expect that those engaged in importing oil will accept their public responsibilities . . ." They are not now doing so, he said.

Because of this, he said, "it is a natural impulse to be impatient and intolerant." But if the long efforts preceding "the progress made during the past year" are continued, he added, they will result "in further progress and a final solution in the best interests of all."

Brown's comment . . . "I believe we have much cause for encouragement," Brown told the I.P.A.A.

The problem, he said, "is moving definitely in the direction of solution."

"In my judgment real progress has been made during the past year . . . The fact that imports have continued at excessive levels should not make us lose sight of the significance of developments of the past year."

He described the continued increase in imports as a "shocking example of irresponsibility to our industry, our Government, and our national security." And he praised Flemming for his "forthright and constructive efforts" to reduce them.

Flemming letter raises questions, but . . .

. . . Imports Action Due

WASHINGTON. — Importers have another chance to bring crude-oil imports down to the cabinet committee formula voluntarily.

If they don't, the Government will consider action under the national-security provision of Section 7 of the Reciprocal Trade Act, Dr. Arthur S. Flemming, director of the Office of Defense Mobilization, told a House judiciary investigating subcommittee November 2.

Flemming said the administration is "trying to exercise leadership" in giving the industry a chance to get its house in order. He will use force only as a last resort, he said.

His testimony followed a letter to importers which left the industry puzzled over its exact significance. This letter:

. . . **Excluded Canada and Venezuela** from the imports picture. It has always been the policy in Government, Flemming explained later, to consider those countries and others in this hemisphere as within the U. S. orbit when dealing with defense questions.

Also, he said, Canada is supplying oil needed by the Northwest deficit area.

. . . **Asked for a cut** of 7 per cent in crude-oil imports from other countries. Flemming said he hopes it will take place this month and continue through the first quarter of next year. The cut will amount to about 25,000 bbl. daily.

. . . **Said residual imports** are now in line with the recommended level.

. . . **Set up a system** calling for regular reports from importing companies on their plans. The first forms are due to go to importing companies this week.

The puzzle . . . Most questions over Flemming's letter to importers arose over this paragraph:

"With the exception of oil of Canadian and Venezuelan origin, and assuming that imports from these areas do not rise appreciably above present levels, importers of oil from other areas should further reduce their planned imports of crude oil for the period April 1-December 31, 1955, by approximately 7 per cent, if a substantial conformity with the advisory committee recommendation with respect to crude oil is to be achieved."

This appeared to many to mean that total imports would not be brought down to the recommended level.

If imports from other countries were cut 7 per cent, their ratio to domestic production would approximate their 1954 ratio.

But if imports from Canada and Venezuela remain unchanged, the cut in other countries would affect only about half the total crude imports. The cut, thus, would fail by quite a bit to bring total crude imports into line with the committee formula.

Flemming told the investigating committee that if Canada and Venezuela are excluded, crude-oil imports from other countries, based on their 1954 relationship to domestic production, should amount to 10.2 per cent of U. S. output. Actually, this figure results from leaving out Canada, only, from the 1954 picture. With both excluded, imports from other countries represented only 4.69 per cent of U. S. production.

Many who read the letter wondered how a 7 per cent cut in November and December would bring imports into line for the 9-month period beginning April 1. It later was explained that a 7 per

cent cut through the first quarter of 1956 was expected.

Residual aspects . . . Flemming said in his letter that residual-fuel imports have ceased to be a problem.

He told the investigating committee his appeal to the importing companies had brought residual imports down within the government formula and had improved the crude situation. His latest letter, he said, may bring crude into line.

Actually, an increased demand for residual in Europe and elsewhere has tightened up the market in the Caribbean area, has cut its availability to the United States, and has raised prices.

Much of the recent movement of heavy fuel oil from California to the East Coast has been due to the tight market in the Caribbean.

Importer list growing . . . Flemming disclosed that since he first called for a cut in imports, he has added 22 importing companies to his list. There are now 40.

Some of the additions are new to the imports field. Others are smaller companies which simply were not included in the first list.

The companies now on the list are:

Asiatic Petroleum Corp., Atlantic Refining Co., Cities Service Co., Eastern States Petroleum Co., Gulf Oil Corp., Phillips Petroleum Co., Shell Oil Co., Shell Caribbean Petroleum Co.

Sinclair Refining Co., Socony Mobil Oil Co., Inc., Southwestern Petroleum Co., Standard Oil Co. of California, Standard Oil Co. (Ind.), Standard Oil Co. (N. J.), Sun Oil Co., The Texas Co.

Tide Water Associated Oil Co., McBride Oil Co., Crown Central Petroleum Corp., Douglas Oil Co. of California, First National Oil Corp., Hess Fuel Co., International Refineries, Inc., Lake Superior Refining Co.

Malco Refineries, Inc., Mohawk Petroleum Corp., Old Dutch Refining Co., Paragon Oil Co., Inc., Republic Oil Refining Co., Richfield Oil Corp., Southeastern Oil, Inc., Southwestern Oil & Refining Co.

Stewart Petroleum Co., Wilshire Oil Co., Inc., Woodley Petroleum Co., Northwestern Refining Co., Great Northern Oil Co., Aurora Gasoline Co., Leonard Refineries, Inc., Wisconsin Oil Refining Co., Inc.

Gilsonite Contracts Let

GRAND JUNCTION, Colo.—American Gilsonite Co. has let contracts to Foster Wheeler Corp., New York, and Kaiser Engineering, Oakland, to build units at its new coke and gasoline plant near Fruita *(The Oil and Gas Journal, June 27, page 75)*.

Foster Wheeler will build the delayed coking unit. Kaiser will set up the calcining plant, utilities and auxiliary facilities. The contracts totaled $5 million.

The plant will refine high-octane gasoline and coke from gilsonite, a bituminous solid. Capacity will be 600 to 700 tons daily—equal to 2,000 bbl. daily in volume. The company will pipe the gilsonite in slurry from mines near Bonanza, Utah.

Penn Grade Price Raised

BRADFORD, Pa. — Purchasers of Pennsylvania Grade crude raised prices November 1.

Bradford, Middle district, and Southwest grades advanced 15 cents a barrel. West Virginia and Buckeye grades were raised 14 cents, and Zanesville crude moved up 5 cents a barrel.

Joseph Seep Purchasing Agency of South Penn Oil Co., the first company to announce the increase, said that demand for Pennsylvania Grade crude had increased following the settlement of strikes at two refineries using Pennsylvania Grade crude.

The new postings are Bradford, $3.75; Middle district, $3.62; Southwest Pennsylvania, $3.33; West Virginia, $3.21; Buckeye grade, $3.15; and Zanesville grade, $2.87.

Tampa Refinery Set

Work will start soon on 25,000-30,000-bbl. plant

DALLAS.—A group headed by E. Constantin, Jr., Dallas producer and financier, will soon start construction of a 25,000 to 30,000-bbl. refinery on Tampa Bay near Tampa, Fla.

Constantin confirmed earlier reports of the project. He said the refinery would be erected on a site near Black Point southeast of Tampa and adjoining a new plant built by Tampa Electric Co.

The refinery will have a large cracking capacity, he said, but declined to elaborate on the units planned or the backers in the deal.

Constantin, besides being an oil producer, is president and general manager of Southland Co., a Mississippi oil-refining concern. The company, headquartered in Yazoo City, Miss., operates a 5,500-bbl. asphalt refinery at Yazoo City, producing 2,000 bbl. of straightrun asphalt daily.

Southland also owns Paluxy Asphalt Co., which operates a 5,600-bbl. plant at Sandersville, Miss. This plant has thermal operations totaling 1,600 bbl. daily and polymerization capacity of 90 bbl. daily. It also produces asphalt —about 200 bbl. a day of straightrun and 100 bbl. of oxidized asphalt.

Equipment Flowing in at New Tide Water Refinery

The site around the refinery being built by Tide Water Associated Oil Co. at Delaware City, Del., is beginning to look more like an army port of embarkation every day. Nearly 60 trucks and 10 freight cars are arriving daily, bring items from screws to large transformers. These valves arrived a little too late to squeeze inside the temporary warehouse and are confined to a storage yard. Tide Water engineers estimate that by on stream time in late 1956 more than 50,000 truck shipments and 10,000 freight cars will have been unloaded.

Line Building Cut

New pipeline construction is well below 1954 figure

WASHINGTON. — New crude and products pipelines laid this year will be less in both mileage and cost than in 1954.

An estimated 4,835 miles of new line will be built this year at a cost of $184,584,900, the Committee for Pipeline Companies reported last week. Last year 5,340 miles were laid at a cost of $236,043,000.

New crude lines will total 1,732 miles costing $74,188,900, the committee estimated. This compares with 2,478 miles laid in 1954 at a cost of $130,397,500. New products lines will add up to 3,103 miles worth $110,396,000—a slight gain over last year, when 2,862 miles were laid at a cost of $105,645,000.

The committee also expects 1,502 miles of existing crude lines to be converted to products service, against 550 miles switched last year.

Biggest projects . . . Largest of the 1955 crude projects is the $19,500,000, 419-mile, 10-12-16-in. line of the Butte Pipe Line Co. from Poplar, Mont., to connections with Service Pipe Line at Fort Laramie, Wyo., and Platte Pipe Line at Guernsey, Wyo. Next in size is Minnesota Pipe Line Co.'s 260 miles of 16-in. from a connection with Lakehead pipeline at Clearbrook, Minn., to Great Northern Oil Co.'s refinery at Pine Bend, Minn. This line cost $12,500,000.

The $40,000,000 military 8-in. line running 625 miles from Haines to Fairbanks, Alaska, tops the products projects. It is followed by the 846-mile, 8-12-16-in. line of Southern Pacific Pipe Lines, Inc., from Phoenix to Los Angeles. Cost is $30,000,000.

Pincher Creek Plant Planned

LETHBRIDGE, Alta. — Canadian Gulf Oil Co. plans to construct elaborate field processing facilities for natural gas in the Pincher Creek field 50 miles southeast of here. Gulf recently contracted to supply 1.3 trillion cu. ft. of gas to Trans-Canada Pipe Lines.

Gulf plans first to build a plant to process 55 million cu. ft. of sour gas daily. Byproducts will be 1,900 bbl. daily of condensate and 225 tons of sulfur. The processed gas will be returned to the reservoir pending start of deliveries to Trans-Canada.

Gulf's field plant will be the largest sulfur producer in Canada. If gas deliveries eventually rise, the company plans to expand operations to produce 350-500 tons of sulfur daily. Initial sulfur output will be sold to Northwest Nitro-Chemicals, Ltd. The company is building a large ammonia plant in Southern Alberta.

Work on Gulf's plant will start soon with completion scheduled for next September.

Gas Found in Lake

Offshore test uses first drilling barge in Canada

TORONTO.—A shallow gas discovery has been completed under 15 ft. of water about a mile offshore in Lake St. Clair east of Detroit.

The wildcat, 5-A Lake St. Clair, tested gas on open flow at a calculated rate of 2,000 M.c.f. per day in a preliminary test after acidizing. Production is through perforations at 1,464-77 ft.

The discovery is one of a series of wildcats being drilled by Harold L. Strader, Houston contractor, for Lake St. Clair Gasfields, Ltd., Toronto. The tests are being sunk from a drilling barge, said to be the first ever to operate in Canadian waters.

Designed for drilling in water 20 ft. deep, the barge has been at work in Lake St. Clair since June. It was transported to Canada from Houston, traveling up the Mississippi River, the Illinois River, and Chicago's Sanitary Canal to Lake Michigan. From there it passed through the Straits of Mackinac, into Lake Huron, and down the St. Clair River which flows into Lake St. Clair. The voyage took 29 days.

The gas discovery is on a block of about 100,000 acres held by St. Clair Gasfields, Ltd. The acreage lies along the south shore of the lake, just east of Detroit. Strader recently announced plans to drill at least 10 wildcats to test gravity-meter anomalies in the area.

New Town-Lot Boom Looms

LOS ANGELES.—Another town-lot drilling boom, reminiscent of Huntington Beach, may be in prospect for neighboring Sunset Heights. Albercalif Petroleum Co.'s 23 Albercalif-Crawford reportedly flowed 2,700 bbl. on its first 24-hour test after being deepened from 6,800 ft. to 7,858 ft.

Albercalif originally completed the well last June for 32 bbl. daily. Its producing interval was 6,370-6,650 ft. Then last October 8, Superior Oil Co. brought in its 2-1 Halbrook-Isabel-Howard location southeast of 23 Albercalif. Superior's well flowed 950 bbl. daily from the perforated interval of 7,728-7,753 ft.

Canadian Briefs

CALGARY.—Construction will start next spring on a 169-mile natural-gas pipeline to supply the Hinton pulp mill 180 miles west of Edmonton. The provincial government has approved the project. The line, to cost $5,250,000, will run from the Alexander Indian Reserve 31 miles northwest of Edmonton. It will be a joint venture of North Canadian Oils, Ltd., Calgary, and Mid-Western Industrial Gas, Ltd., Edmonton, which has gas wells on the reserve.

CALGARY.—Okalta Oils, Ltd., has taken over management of Consolidated Gordasun Oils, Ltd., and New Concord Development Corp., Ltd., and has grouped all three into a single operating unit. The combined net working capital exceeds $1,500,000.

REGINA.—Work is completed on the Saskatchewan Power Corp.'s 116-mile natural-gas pipeline from Coleville gas field to Saskatoon. The 14-in. line will assure supplies to the Saskatoon and Prince Albert areas and several towns along the route.

CALGARY. — Geophysical Service, Inc., of Dallas, Tex., which has field parties working over most of the world, has purchased Rogers Exploration Service, Ltd., of Calgary for an undisclosed sum. C. M. Moore, Jr., president of G.S.I.'s Canadian affiliate, Geophysical Service International Corp., will become president of Rogers Exploration. John O. Rogers, former owner, will remain with the company. It has three gravity-meter field parties under contract to oil companies.

REDWATER, Alta.—Imperial Oil, Ltd., has let a contract to Brown & Root, Ltd., to build a $3 million, 10,000,000 cu. ft. natural-gasoline plant near here. Construction will begin next spring and be completed by late 1956.

TORONTO.—Girdler Corp. of Canada, Ltd., has received a contract from Canadian Industries (1954) to erect a 200-ton per day synthetic-ammonia plant at Millhaven, Ont. It will be based on residual fuel oil.

The plant will use the Texaco partial oxidation process to produce hydrogen from fuel oil *(The Oil and Gas Journal, September 19, page 80).* The Millhaven plant, due for completion the middle of next year, will be similar to one which Girdler Corp. is building for Northern Chemical Industries at Searsport, Me.

Conoco Ups Offshore Bet

Continental, already the biggest tidelands leaseholder, adds 51,840 more acres off Texas in deal with Shell Oil

HOUSTON.—Continental Oil Co. has purchased half interest in Shell Oil Co. leases covering a 103,680-acre block off the coast of Texas.

The acreage includes 18 tracts in the High Island area east of Galveston. The block, largest ever leased by a single company off the coast of Texas, ranges about 50 to 65 miles from shore.

L. F. McCollum, Conoco president, announced that the agreement gives his company 51,840 net acres in the big block leased by Shell. The deal also provides that the two firms will share the cost of drilling each well in the block.

Shell, which will be operator for the two companies, recently announced plans for drilling the first test in that section of the tidelands. The initial well, farther from shore than any yet drilled, will be in Block A-104. It will be 63 miles from the coast and in water about 93 ft. deep *(The Oil and Gas Journal, October 24, page 66).*

Glasscock Drilling Co.'s giant mobile platform, "Mr. Gus," will be moved to the Shell-Continental site after finishing its current assignment for Humble Oil & Refining Co. off Mustang Island. Plans call for starting the new test in December.

Shell paid bonuses totaling $5,423,000 for the block in the federal Government's most recent sale of offshore leases last July. Terms of the deal with Continental were not announced.

Acreage involved . . . The acreage covers federal Blocks A-71 through A-74, A-76 through A-80, and A-98 through A-106.

A pioneer in offshore operations and one of the most successful companies working in the Gulf of Mexico, Continental also is the largest leaseholder in the Texas and Louisiana tidelands.

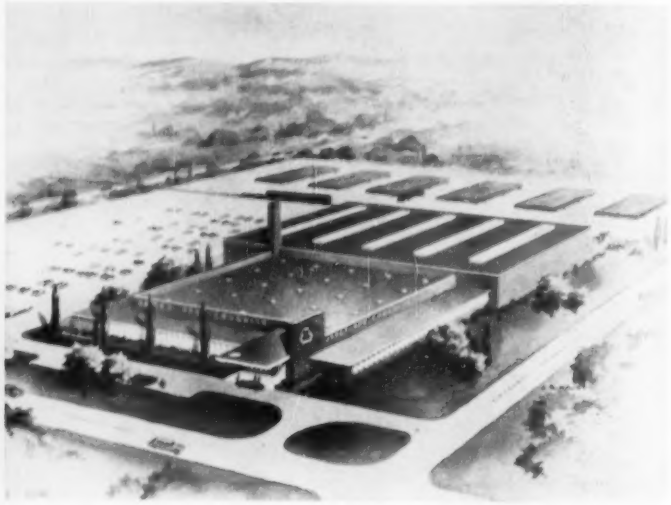
The company now has an interest in 691,000 acres submerged by the Gulf of Mexico. This includes 146,000 acres off Texas and more than half a million acres off Louisiana. Conoco has an interest in some 83 oil and gas wells in the tidelands.

In other operations off the Texas coast, Pure Oil Co. is preparing to drill its first well in Block 212, Galveston area. The test will be about 2 miles southwest of the Block 189 field and 12 miles southeast of Galveston.

A four-well fixed platform is being erected at the site by Brown & Root Marine Operators, Inc.

Pure and associates now have three gassers and are drilling a fourth well in Blocks 189-190.

The over-all wildcat picture off the Texas coast is: seven rigs now active, two new tests to start when barges are available, and permits asked for erection of drilling structures in five other areas.



J&L Salutes Old Store, Starts New Building

TULSA. — Jones & Laughlin Steel Corp.'s Supply Division celebrated the fiftieth anniversary of one of its oldest stores one day last week. The next day ground was broken on a new $1,500,000 headquarters building here.

The new Tulsa building is part of $250,000,000 earmarked for expansion between now and 1958. The expansion will increase J&L's ingot capacity over 700,000 tons. Present annual ingot capacity is about 6,200,000 tons. The current expansion will boost J&L's postwar expansion to over $700,000,000.

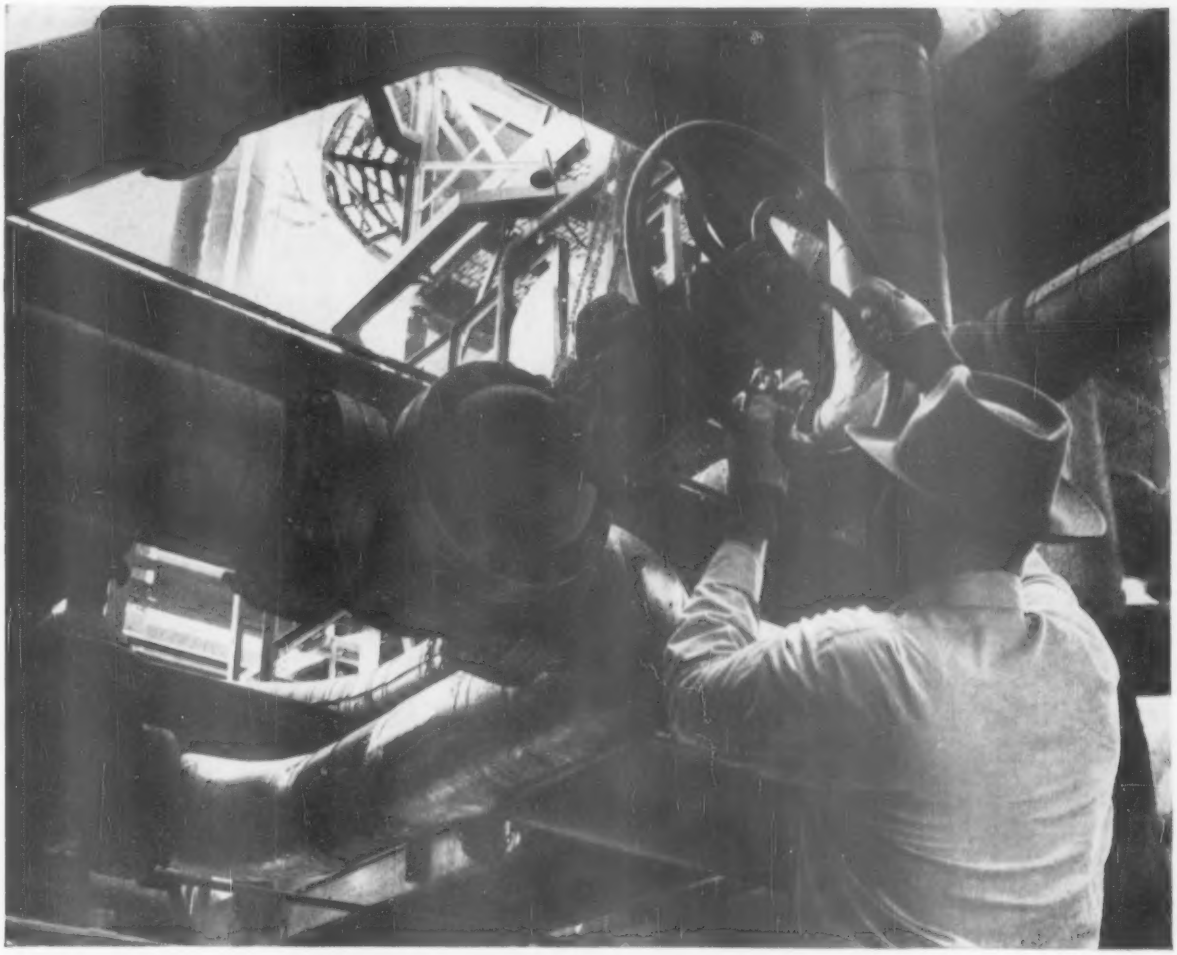
C. L. Austin, Pittsburgh, president of the corporation, and Rainey Elliott, Tulsa, supply division president, were among the principals in the groundbreaking ceremonies. They also were host at the celebration, which commemorated the long service of the company's Bartlesville, Okla., store.

The store is the oldest supply outlet serving oil-industry customers from one location west of the Mississippi River. It was opened in its present location in 1905 by the old Frick-Reid Co. of Pittsburgh.

J&L acquired majority interest in Frick-Reid in the early 1930's and became sole owner in 1940. Frick-Reid Co. became Jones & Laughlin Supply Co. in 1944. In 1953, the supply company was set up as the supply division of J&L Steel.

The Bartlesville store is now part of a network of 91 stores located in 18 states and Canada.

The Tulsa building, which will include 100,000 sq. ft. of floor space, is scheduled for completion next September.



8 years on 600° F. oil...
and never a wrench on these Crane Valves

THE CASE HISTORY—Here is one of the 8-inch, 300-pound Crane steel gate valves in service on a crude unit at Cities Service Oil Co.'s Ponca City refinery. They're on the 600° F. oil transfer line from the furnace where they were installed more than 8 years ago.

The refinery's engineers chose No. 33X gates to stop a condition of continual leakage at the packing glands with other makes of valves formerly used. They did that—and more. In service continuously, the Crane valves have needed no maintenance whatsoever—have never leaked—and to date are giving tight closure with easy operation.

There's a difference in steel gate valves that doesn't show on the surface. In Crane valves, it's in the 100-year skill with which Crane makes castings . . . the care given to design . . . the closely controlled heat treating and finishing of Crane Exelloy seating. These added values account for the outstanding low-cost performance record of Crane valves in the petroleum industry.

In steel gates, globes, angles and checks, Crane gives you complete selection—in sizes up to 24 inches—in pressure classes up to 2500 pounds. Your local Crane Representative can give you valuable help in specifying and ordering these valves.

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Gas Producers Lose

Escape clauses canceled in sweeping FPC ruling

WASHINGTON.—A Federal Power Commission examiner last week canceled escape clauses in contracts of independent natural-gas producers subject to FPC regulation.

Examiner Daniel J. Kelly held that producers selling gas to pipeline companies for resale in interstate commerce are not exempt from regulation and can abandon service only with FPC consent.

Kelly held 14 producers in the Clayton and La Gloria fields in Texas must continue to supply gas to the Texas Illinois Natural Gas Pipeline Co.

The examiner ruled that the exemption clause in the Natural Gas Act does not apply to a producer "regardless of what he may do with the gas after the production and gathering of it.

"These sales are made to pipeline companies for resale in interstate commerce, and the respondents who make such wholesales of natural gas are without question natural-gas companies—subject to the jurisdiction of the commission under the holding of the Supreme Court in the Phillips case," Kelly said.

The 14 producers involved are the Argo Oil Corp., Magnolia Petroleum Co., Brown & Wheeler, Continental Oil Co., Fidelity Oil & Royalty Co., Mound Co., R. A. Welch, La Gloria Oil & Gas Co., Ohio Oil Co., Phillips Drilling Corp., Irene Sheerin, C. C. Small and Binford Arney, James Lawrence Sheerin and Robert Malcolm Sheerin, Sun Oil Co., and the Wiltex Corp.

The producers had escape clauses in their contracts providing for cancelation if the FPC decided to regulate them. Texas Illinois complained to the commission that it had received termination notices.

Kelly declared the producers failed to show cause why they should not obtain FPC approval before cutting off gas deliveries.

New Pipe Mill Contracted

EDMONTON.—A $7,000,000 pipe mill with yearly capacity of 150,000 tons will be built here by Alberta Phoenix Tube & Pipe, Ltd.

The mill will be financed by Canadian capital in conjunction with specialized pipe manufacturers from Germany who recently opened a plant near Vancouver. It will produce pipe from 3½ to 12¾ in. in diameter to A.P.I. specifications. Backers include Frank M. McMahon, head of Westcoast Transmission Co., and Phoenix Rheinrohr, A.G. of West Germany, one of Europe's major pipe and steel firms. Canadian Bechtel, Ltd. has signed a contract to manager the project.

Trans-Canada Orders Pipe

CALGARY.—Trans-Canada Pipe Lines, Ltd. has ordered 562 miles of 34-in. pipe from U. S. Steel Corp. for the Saskatchewan-Winnipeg leg of its proposed 2,250-mile line. The $30,000,000 order, involving 200,000 tons of high-pressure steel pipe, is one of the largest ever placed for a gas line in the U. S. or Canada.

U. S. Steel will start turning out the 40-ft. joints in February and will complete the contract late next summer. Trans-Canada hopes to start construction next spring. The whole deal hinges on approval by the U. S. Federal Power Commission of the gas import-export plan which is the key to financing the all-Canadian line.

CONCRETE-COATED 30-IN. slides under river in final stages of pipe-laying construction on Texas Eastern's Beaumont to Kosciusko line.

Texas Eastern Testing New Line

SHREVEPORT.—Texas Eastern Transmission Corp. has completed pipe-laying operations and is testing its new 377-mile, 30-in. natural-gas transmission line from near Beaumont, Tex., to Kosciusko, Miss.

The $70,883,000 line connects at Kosciusko with the company's existing 30-in. system extending northeast to Connellsville, Pa.

It will offset the 200,000,000 cu. ft. daily of transmission capacity which Texas Eastern expects to lose when it converts the Little Big Inch to products.

All that now remains is completion of compressor facilities on the new line. Work is moving ahead rapidly on seven new compressor stations totaling 89,200 hp. and on additions to existing stations totaling 31,020 hp.

The new stations are at Vidor, Tex.; Egypt, Miss.; Mount Pleasant, Tenn.; Owingsville and Tompkinsville, Ky.; Athens, Ohio; and Holbrook, Pa. Compressor capacity is being added at stations at Kosciusko; Barton, Ala.; Gladeville, Tenn.; Danville, Ky.; and Wheelersburg, Ohio.

Texas Eastern also is building a new 2,200-hp. compressor station on its 24-in. system near Booth, Tex.

Construction of the entire project was coordinated in the field by Brown & Root, Inc., Houston, which also is building the compressor stations.

Pipe contractors . . . Pipe-laying contractors were: Houston Contracting Co.; Tulsa Williams Co. (Williams Brothers); H. C. Price Co.; and H. B. Zachry Co.

Houston Contracting laid roughly 60 miles from near Beaumont to near DeQuincy, La. Tulsa Williams laid 118 miles from DeQuincy to New Roads, La.; Price, 134 miles from New Roads to Clinton, Miss.; and Zachry, 64 miles from Clinton to Kosciusko.

The project included crossings of the Neches, Sabine, Atchafalaya, and Mississippi rivers and of the Bayou Courtableau. Two submarine lines were laid at all crossings for added protection.

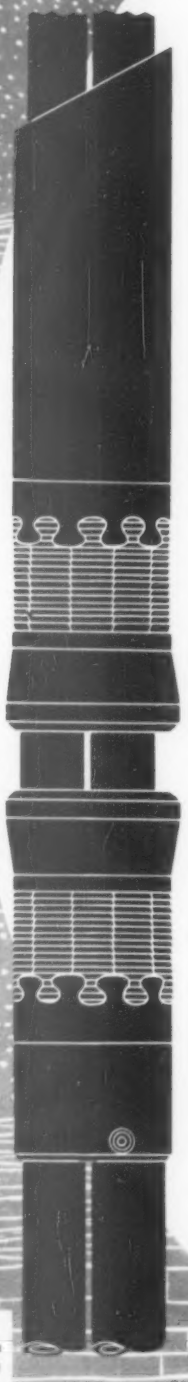
The Neches and Atchafalaya crossings were handled by Pentzien, Inc.; the Sabine and Bayou Courtableau jobs by Missouri Valley Dredging Co.; and the Mississippi project by J. Ray McDermott Co.

BROWN

SOS Detachable

DUAL STRING PACKER

NEW — SIMPLE IN DESIGN AND OPERATION — RETRIEVABLE, ECONOMICAL — ELIMINATES EXTRA EQUIPMENT — SETS AUTOMATICALLY, NEEDS NO SURFACE MANIPULATION OR TUBING WEIGHT



(Picture shows two 2" tubing strings in 7" pipe.)

1. Each tubing string is run or pulled separately — without the usual dual string clamps, and extra handling equipment — thus saving considerable time and money.
2. Permits PERMANENT COMPLETION of lower zones — full opening string with minimum or no tubing weight.
3. Eliminates possibility of complicated fishing operations.
4. The Detachable String Packer is run in with one string (with stinger below for lower zone packer), then the second string is run independently and automatically latches into and packs off in the packer without rotation. The 45° concave surface at top of packer simply guides this string into place. To release this string only right hand rotation is required.

Advantages of Dual String Installations

- Leave mud in casing annulus with no pressure existing other than hydrostatic head of mud column.
- Handle both zones separately at all times so they are never thrown together.
- Install sub-surface controls in both strings so they may be serviced separately.
- Be able to swab, treat or pump either zone separately without interfering with production from the other.

For further information, write: Brown Oil Tools, Inc.

BROWN OIL TOOLS, INC.
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HOUSTON, TEXAS

Total Demand to Rise 3.4 Per Cent

ST. LOUIS.—Total demand in 1956 will average 8,997,000 bbl. daily, an increase of 3.4 per cent over 1955.

This forecast was presented to the Independent Petroleum Association of America here last week by the association's supply and demand committee.

The committee also revised upward its forecast for 1955. Total demand this year now is expected to average 8,697,000 bbl. daily. This is an increase of 7.3 per cent over 1954—a gain nearly double those made in 1954 and 1953.

The committee's original forecast for 1955 called for an average demand of 8,370,000 bbl. daily *(The Oil and Gas Journal, November 1, 1954, page 61)*.

The unexpectedly high demand this year was credited to a "marked resurgence in general economic activity." Next year, however, the committee foresees a level of business activity "only slightly higher than in 1955."

To meet the higher demand in 1956, the committee said, supply must average 9,004,000 bbl. daily. But what this means to the domestic producer, it cautioned, will depend on the volume of imports and the production of natural-gas liquids.

Gas-liquids output is expected to average 743,000 bbl. daily next year, the committee said. Imports it found less predictable.

If imports next year bear the same relationship to domestic production they did in 1954, crude output will increase 311,000 bbl. daily, the committee said (see small table).

However, if imports show as big a percentage increase next year as they have this year, domestic production will rise only 18,000 bbl. daily.

Actually, the committee said, domestic demand next year will rise 4 per cent. But a drop of 9.6 per cent in exports will result in a net gain in total demand of 3.4 per cent.

Biggest increases in product demand next year are expected to be in distillate and gasoline. Distillate demand, the committee predicted, will rise 5.2 per cent over this year. Gasoline demand is seen as going up 4.1 per cent.

(The Oil and Gas Journal's annual forecast of supply and demand will appear in the November 14 issue.)

IMPORTS' EFFECT ON PRODUCTION

Basis of assumption—	Estimated import levels 1,000 B/D	Domestic crude-oil production 1,000 B/D	Increase over 1955 1,000 B/D	Increase over 1955 Per cent
(a) Imports at 1954 ratio to domestic crude-oil production	1,176	7,085	311	4.6
(b) Imports at 1955 level	1,243	7,018	244	3.6
(c) Imports increased by same percentage as in 1955 (18.2 per cent)	1,469	6,792	18	0.3

U. S. Petroleum Supply and Demand Forecast

(Thousands of barrels daily, except closing stocks)

	3rd quarter 1955*	4th quarter 1955	Year 1955	1st quarter 1956	2nd quarter 1956	3rd quarter 1956	4th quarter 1956	Year 1956
DEMAND:								
Gasoline	3,910	3,653	3,697	3,458	4,070	4,065	3,798	3,848
Kerosine	210	462	330	480	179	206	447	328
Distillate	1,130	1,975	1,633	2,414	1,233	1,176	2,052	1,718
Residual	1,380	1,693	1,605	1,868	1,485	1,390	1,685	1,607
Other products	1,595	1,390	1,432	1,361	1,525	1,636	1,455	1,496
Total	8,225	9,173	8,697	9,581	8,492	8,473	9,437	8,997
EXPORTS (included above):								
Gasoline	105	90	92	80	87	90	83	85
Kerosine	15	11	11	10	10	11	10	10
Distillate	75	69	66	54	62	63	63	60
Residual	85	78	91	86	80	70	68	76
Other products	75	68	72	65	69	67	65	67
Crude	30	30	31	28	33	29	30	30
Total	385	346	363	323	341	330	319	328
DOMESTIC DEMAND	7,840	8,827	8,334	9,258	8,151	8,143	9,118	8,669
TOTAL STOCK CHANGE	263	—213	29	—388	342	388	—317	7
TOTAL NEW SUPPLY REQUIRED	8,488	8,960	8,726	9,123	8,834	8,861	9,120	9,004
CLOSING STOCKS (millions barrels):								
Gasoline	151.3	159.3	159.3	185.1	160.0	149.3	159.2	159.2
Kerosine	36.4	27.8	27.8	18.2	28.6	36.4	27.8	27.8
Distillate	143.7	121.9	121.9	68.2	99.5	141.5	121.5	121.5
Residual	46.8	44.7	44.7	40.8	44.1	48.1	45.5	45.5
Other products and natural gasoline	112.0	111.0	111.0	114.4	119.9	114.0	111.6	111.6
Crude	255.0	260.9	260.9	264.0	269.7	268.1	262.5	262.5
Total	745.2	725.6	725.6	690.7	721.8	757.4	728.1	728.1
RUNS TO STILLS	7,560	7,578	7,466	7,713	7,563	7,739	7,815	7,709

*Estimated based on U. S. Bureau of Mines and A.P.I. figures. Prepared by the Supply and Demand Committee of the Independent Petroleum Association of America.

Rising costs threaten . . .

. . . Slowdown in Drilling

ST. LOUIS.—Rising costs threaten to make it unprofitable for the industry to drill as many wells as it should.

Only two things can keep drilling activity as high as is needed. The industry must either:

. . . Get more income from the crude it produces, either through greater production or higher prices.

. . . Devise new methods of finding and developing reserves.

This warning was sounded here last week by the cost-study committee of the Independent Petroleum Association of America.

Costs of equipment, materials, services, and wages are up 10 per cent since the industry's last crude-price increase in June 1953. In the same period, exploration and development work has climbed 13 per cent. Both gains together mean that total costs of finding and developing reserves are now nearly 20 per cent higher than then.

While exploration costs have soared, the committee said, production is running only 3.8 per cent ahead of 1953 and the price of crude is the same. This means, it said, that total income is lagging behind the rising costs of finding crude.

What's involved . . . There are two major factors in the higher costs, the companies said. These are:

. . . More drilling. Compared with the first 8 months of 1953, the number of wells drilled this year is up 12.7 per cent.

Footage drilled is up 13.7 per cent, and the average depth has increased 0.9 per cent.

. . . Unit costs are up. Comparisons of August of this year and June of 1953 show that: Hourly wages are up 9.2 per cent; tubular goods are up 10.2 per cent; construction costs have risen 11.2 per cent; and structural steel has climbed 17.9 per cent.

Other factors were listed as sharp increases in services such as perforating, and drill-stem testing, the additional cost of new techniques—such as fracturing—and increases in lease bonuses, lease rentals, and seismic operations.

The need for drilling . . . There must be a continuous increase in the volume of drilling, the I.P.A.A. was told.

Demand for crude in this country has doubled in the last 14 years and is expected to double again within the next 20 to 25 years—and possibly sooner.

Both the population and the per-capita consumption are increasing rapidly. Per-capita consumption in 1940 was 10 bbl.; in 1950 it was up to 15.7 bbl. This year it is expected to be 18 bbl., climbing to 21 bbl. by 1960, the committee said.

At the same time, the committee cautioned, it's a bigger job to find oil these days. Between 1935 and 1939, it said, 28.55 bbl. of new oil was found per foot drilled. Between 1950 and 1955 the figure had dropped to 17.26 bbl. per foot.

And it's taking deeper wells to find new oil—at a tremendous increase in drilling costs in the deeper holes.

Too, the average wildcat today isn't nearly so successful as its predecessors.

During the 5-year period ending last December, the average number of wildcats drilled each year was more than four times as great as the average number drilled during 1935-39. The amount of oil found per well, however, was less than 25 per cent of the 1935-39 figure.

"The cumulative effect of increased costs per well, combined with the decreased reserves found per exploratory well, indicates that finding cost per barrel has multiplied many fold," the committee declared.

What to do . . . The industry must act to "obtain . . . a greater recognition" of the use of replacement costs to determine profit or loss.

This recognition, the committee said, is needed in the industry, itself, as well as in the Government and in the accounting, engineering, and economics professions.

Rising costs mean that plowing back 60 per cent of the gross income from production into the search for and production of new oil is no longer enough.

The dollars accumulated through accounting charges for depletion and depreciation are "woefully inadequate," the committee said, to do the job of replacing reserves being consumed and equipment being worn out. Traditional accounting methods, it emphasized, "do not reflect currently higher replacement costs of finding and developing new reserves."

Replacement costs, the committee concluded, "must be more carefully studied" and given full recognition of their importance.

Processing Briefs

YORKTOWN, Va. — American Oil Co. has contracted with the Ralph M. Parsons Co. of Los Angeles to construct three refining units for its new 35,000-bbl. per day refinery here. Included are a 7,600-bbl. per day Ultraforming unit, a naphtha desulfurization unit to hydrogen treat Ultraformer feed, and a 15,000-bbl. per day hydrogen treater to desulfurize gas oils.

LOUISVILLE, Ky.—Stauffer Chemical Co. will build another multimillion dollar petrochemical plant here to produce carbon tetrachloride, chloroform, methylene chloride, and anhydrous hydrogen chloride. Raw materials will be natural gas and chlorine. Construction is to begin early next year with completion sometime in 1957.

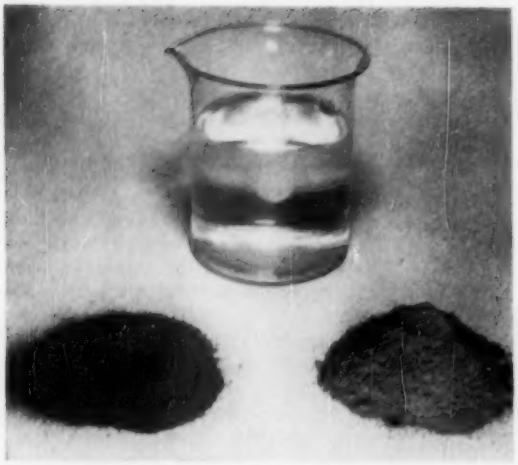
CASPER, Wyo.—A 4,800-bbl. cat-alytic reforming unit is scheduled for completion early next year at The Texas Co.'s 17,000-bbl. daily Casper refinery. This is Texaco's 10th such unit to be built under a $72,000,000 expansion program. Nine other new units with total capacity of 101,000 bbl. daily already are in operation.

BAYONNE, N. J.—Esso Standard Oil Co. is bringing its wax Hydrofining unit down for a turnaround here. During the 1-week changeover, the unit will be boosted in capacity from 2,500 to about 3,750 bbl. per day, to meet increasing demands for high-quality waxes.

WARREN, Pa.—Two explosions and a fire last week damaged several oil tanks and buildings at the Seneca plant of United Refining Co. here. The $500,000 damage was restricted to the Seneca division.

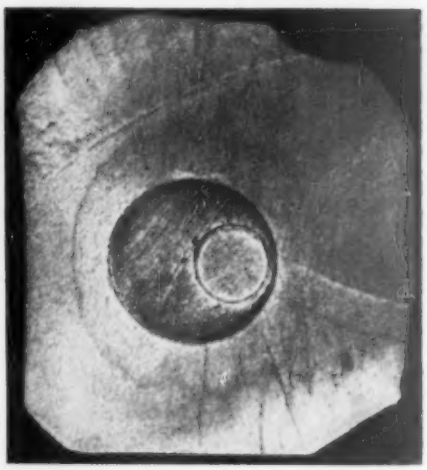
TULSA.—Bareco Oil Co. directors have approved sale of the company's Barnsdall, Okla., wax refinery and its wax business to the Petrolite Corp. for Petrolite capital stock. The sale awaits final approval by stockholders of both firms. Wax operations of the two companies will be combined under the name of Bareco Wax Co., a division of Petrolite Corp.

DELAWARE CITY.—Construction has begun on a vapor recovery gas plant at Tide Water Associated Oil Co.'s new 130,000-bbl. refinery here. The unit is designed to handle more than 90,000,000 cu. ft. of gas per day. The gas will come from the plant's crude distillation, catalytic cracking, reforming, coking, and other units.



INGREDIENTS are phosphoric acid, beaker, fluoride, left, aluminous material, right.

SLURRY is nonviscous and flows easily.



DEXET is set up in sandstone core-drill hole coated with mud cake.

Versatile material has many uses . .

. . . Dowell Develops Brand New Cement

Kenneth B. Barnes

TULSA.—Development of a new cement designed especially for oil-well usage was disclosed last week by Dowell Incorporated.

It is not portland cement with new additive agents, nor is it a plastic. It is an entirely new material, called Dexet, produced during some 18 months' intensive research.

The components are a phosphoric-acid solution and aluminous material. A fluoride additive compound acts as an accelerator. The various parts can be readily mixed in standard cementing and pumping equipment.

How it works . . . The new-type cement sets as a result of chemical reactions between the phosphoric acid, used as a 35 per cent inhibited solution, and the powdered aluminous material. The reaction proceeds very slowly unless speeded up by the powdered fluoride accelerator, which makes possible the controllable setting time.

The slurry can be mixed at a central station and delivered to the well location in a paddle truck or tank unit. It can be held for as long as 72 hours before application. After addition of the accelerator, sometimes called "exciter" or "trigger," the slurry will set within a controlled time of 1½ to 8 hours.

Uses and advantages . . . The development report covering the new cement pointed out advantages in solving specific oil-well cementing problems. Field service will be beamed especially toward jobs involving squeezes, setting liners, plugging back formations that produce unwanted fluids, and setting bottom-hole plugs prior to remedial work. The cement will be used also in setting plugs for whipstock drilling and some classes of long-string work.

Approximately 65 field jobs have been made with the phosphoric acid-aluminous cement. These have been in the Texas Gulf Coast area and around Grayson County in North Texas. Jobs will be confined to these two areas for the time being.

What it does . . . The new cement will:

. . . Eliminate shrinkage. There is actually some expansion.

. . . Resist contamination by drilling muds and mud additives.

. . . Furnish tight bonds to the pipe and the formation.

The new cement material is designed for a formation temperature setting range between 100° and 215° F. Experiments have shown controlled setting is possible up to 350° F., however. The material for the higher temperature is not yet commercially available.

The setting is a chemical process and is dependent upon the temperature and amount of accelerator in the slurry. Twenty per cent of mud by volume can go into the slurry without causing setting failure. Crude oil has no effect, and tests have shown that immersion in prolonged sulfate and sulfide brines does not cause destructive deterioration or substantial loss of strength.

Specifications of the Dexet material are:

Slurry density, lb./gal.	11.5-12.2
Density, under pressure	13.4
Slurry viscosity, cp.	350-400
Slurry gel strength, grams	10-15
Density, set material, lb./gal.	13.4
Permeability, set, md.	0.005
Porosity, set, per cent	7

T.G.T. Enters Pembina

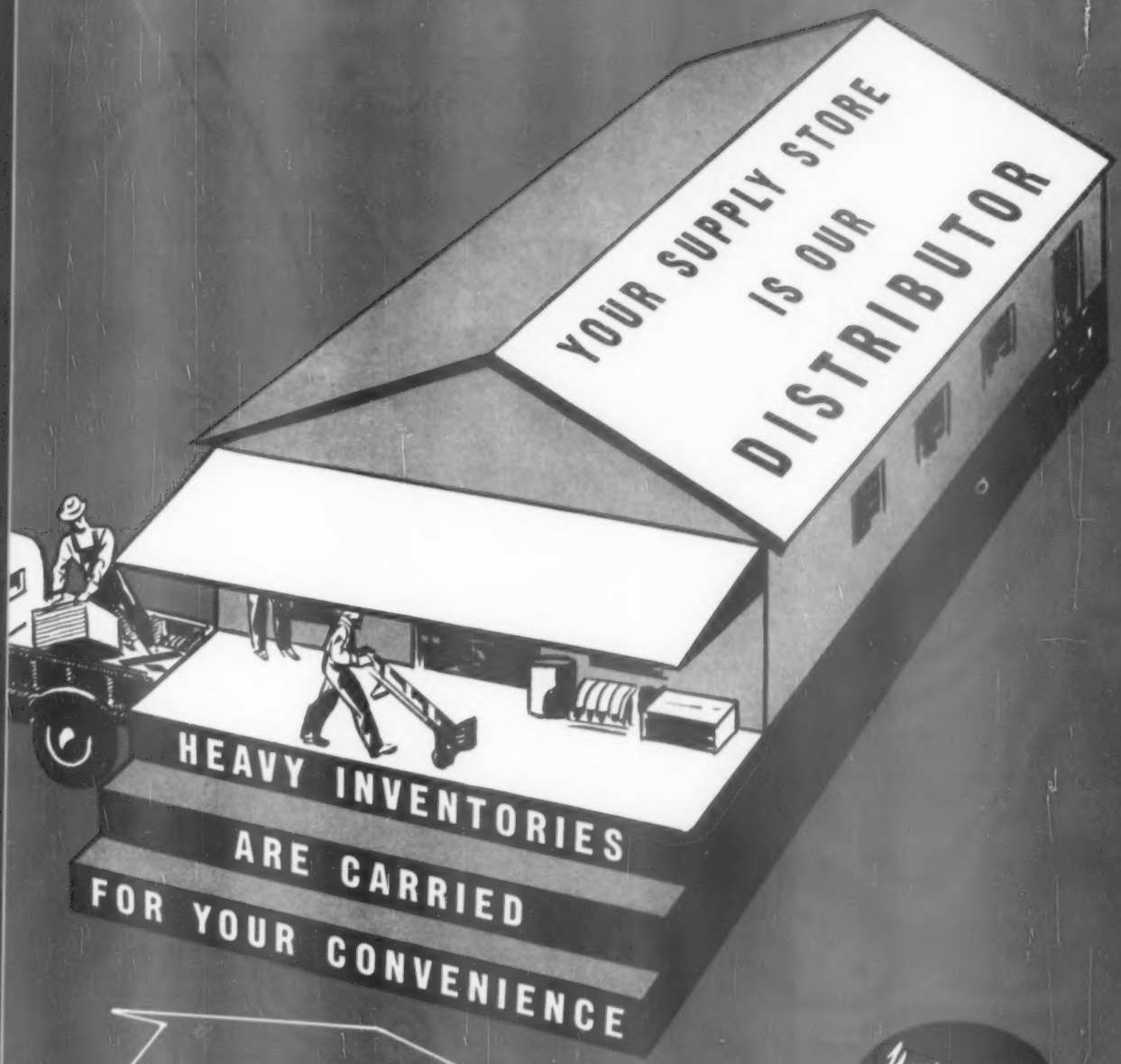
EDMONTON.—Tennessee Gas Transmission Co. has entered the Alberta oil picture by leasing nine parcels in the Pembina area and one at Erskine, 110 miles northeast of Calgary.

The major pipeline company, which also has integrated oil operations, made the top individual bid of $938,412 for a Pembina tract at the government sale November 1. T.G.T. paid $6,555,769 for the 10 parcels.

The choice leases around Pembina, Canada's second-largest producer and still growing, brought $20,669,263 of the $21,610,061 realized by Alberta in the sale. The province has received $415,000,000 for oil and gas rights since the 1947 boom began.

Other bids last week included Canadian Seaboard Oil Co., $5,226,849 for eight Pembina parcels. Home Oil Co., Ltd. and associates paid $5,207,500 for 10 Pembina parcels. Canadian Gulf Oil Co. acquired 2 parcels in the same area for $1,025,484.

A total of $557,488 was paid for rights at Bashaw Erskine, Fenn-Big Valley, Hamilton Lake, Stettler, and Joarcam. Oil rights on unproven lands netted $383,309.



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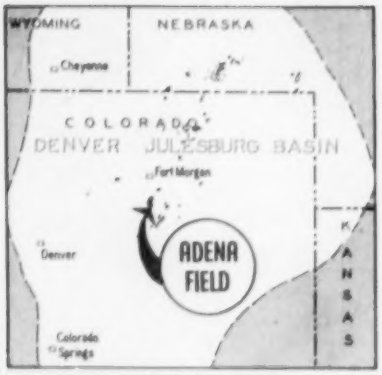


Adena Unit Set

Pure operator for first unitization in Colorado

DENVER.—Colorado's first unitization project came into being last week.

It covers the 177-well, "J"-sand reservoir of Adena field, in Morgan County. It is expected to add 10,000,000 bbl. to the expected recovery through selective operation of existing wells. Another 17,000,000 bbl. is expected ultimately if secondary recovery is undertaken.

As an October 31 deadline passed, 20 of the field's 21 operators had signed the voluntary agreement. The project ended a 19-month unitization drive headed by Pure Oil Co., Adena's biggest operator.

Studies are now under way to determine what type of secondary-recovery method will be used. Water injection is considered probable, with the possible use also of gas injection in the gas area.

W. M. Peck, superintendent of the southwest producing division of Pure Oil Co., which will be unit operator, said the working-interest signatures on the agreement represent more than 92 per cent of the field's area. Royalty-owner signatures represent more than 94 per cent.

Adena is the largest field in the Denver-Julesburg basin and the second largest in Colorado. The "J" sand is a barrier-type stratigraphic trap covering 12,000 acres. Of this area, 8,300 acres are oil productive and 5,000 lie in the gas area.

Primary recovery under competitive operation has been estimated at 44,000,000 bbl. By shutting in high gas-oil-ratio wells, the operators figure 10,000,000 bbl. would be added. Ultimate return through secondary recovery, they figure, would be 71,000,000 bbl.

Next step in the program will be to apply to the Colorado Conservation Commission to formulate field rules to govern those not included in the unit operation.

WATCHING WASHINGTON

Bertram F. Linz

FPC Not Defaulting

The Federal Power Commission isn't going to let any side-stepping of its regulations get by.

For instance, an independent gas producer can't "abandon" service to a pipeline in order to make a new contract for the same gas at a higher price.

That's not abandonment of service, the FPC has held. And a new application to sell gas is unnecessary because the producer has been selling it prior to the Supreme Court decision in the Phillips case.

So the FPC told Bates & Cornell, Lafayette, La. The firm planned to abandon service to the Texas Gas Transmission Co. and then resume it under a new contract at a higher price.

The producers asked to abandon service under a contract made in December 1953. At the same time they asked to sell gas to the company under a new 20-year contract made last July 1. Under the new contract, the price of gas would be increased from 7 to 8.997 cents per thousand cubic feet.

The FPC pointed out it appears the proposals are for the purpose of increasing the rate for gas sold to the pipeline. The proper way to do this is by filing a request for changes in rate schedules, it said.

New Look at the World

Scientists of 40 nations are going to try to learn the exact shape and size of the world—and what makes it tick the way it does.

Their studies will girdle the earth from pole to pole. They may lead to some new ideas for forecasting weather conditions, coping with cosmic interference of radio communications, and even for better use of the seismograph.

Man has lived on earth for thousands of years. He has harnessed the atom. Yet he doesn't know the exact shape of his world, or its exact size.

All these will be studied during the International Geophysical Year which begins in 1957. The research will range from using the Antarctic icecap as a seismic "model"—the oil industry is financing model seismologic studies in universities—to the launching of the much publicized artificial satellites.

Much of the work will be pure science. But its results may help everybody. Offshore oil operators, for instance, would welcome better weather forecasts. Operators using radio would like to see sunspot interference wiped out. Better ways of using the seismograph would help exploration.

More Offshore Trouble

The federal Government's claim that Louisiana does not own submerged resources between the mainland and the offshore islands from which it measures its gulf boundary is taking on added importance.

The same claim is being raised with respect to Florida. This state recently made an exploration contract with The California Co.

The Supreme Court refused last month to make a "quickie" decision on Louisiana's boundary by modifying its 1950 tidelands decree. Since then the Interior Department has protested the Florida contract. It indicated that suits to determine the boundaries of the two states may shortly be filed in the lower federal courts.

Louisiana's claim carries its boundary out some 30 or 35 miles into the Gulf of Mexico. Florida's claim goes much further—some 75 miles or more.

The area on which title is clouded stretches from Key West to Dry Tortugas Island 65 miles west. The California Co. contract covers a section 12 miles wide and nearly 50 miles long in that area.

In a letter to state officials, Clarence A. Davis, acting secretary of the Interior, set forth the federal Government's case. He said it has exclusive right to issue oil and gas leases for all the Continental Shelf lying seaward of the Florida boundary "as that boundary exists pursuant to the terms of the Submerged Lands Act." That law, he said, gives the coastal states only the tidelands within 3 miles from the Atlantic Coast and 3 leagues into the gulf.

The state claims all the water and submerged lands between Key West and Dry Tortugas. They are part of the state under the boundaries set up in the Florida Constitution, which carries the line along the edge of the Gulf Stream to and including Dry Tortugas, it asserts.

World Output Edges Up

Russia's release of Austrian fields bolsters free-world production; several records set by individual countries

Ray G. Gibson

FREE-WORLD crude production rose slightly in August. But several individual countries broke all past records.

A striking gain was made in Iraq, where Iraq Petroleum Co., Ltd.'s fields for the first time produced more than 700,000 bbl. daily. I.P.C. output averaged 712,700 bbl. daily, 10.4 per cent over July, and 5.4 per cent over the previous June high. Most of the increase was accounted for by the Kirkuk field region, which had a record production of 534,300 bbl. daily. British Petroleum Co., Ltd.'s, Khanaquin added about 12,000 bbl. daily to the Iraq total.

The August increase of 68,500 bbl. daily in Iraq exactly matched the rise in Venezuela. Operating companies produced 2,169,600 bbl. daily, surpassing by 19,900 bbl. daily the record set in February.

These gains more than offset a drop of 105,500 bbl. daily in Kuwait. Output in the shaikhdom of 1,046,200 bbl. daily was off 9.2 per cent from July, and 5.4 per cent from the 8-month average of 1,106,000 bbl. daily. Output in the United States rose 33,000 bbl. daily to 6,665,000 bbl. daily. Canadian production was off 23,600 bbl. daily from July to 376,000 bbl. daily.

Changes among other major oil-supplying countries were relatively small. Saudi Arabian production of 940,200 bbl. daily was slightly below the January through August average, 943,500 bbl. daily. Iranian consortium output of 354,000 bbl. daily fell 6,000 bbl. short of the June high, but was 6,000 bbl. above July.

Austrian fields released . . . Free-world production in August averaged 13,628,600 bbl. daily. This included Austrain production reported at about 67,000 bbl. daily when the Russians transferred the fields on August 13 to the Austrian Government. Aside from this output, the free-world gain over July was 57,500 bbl. daily, up about 0.4 per cent.

A predominant feature of the overall picture in August was the number of small crude producers which set new records.

Output in France rose to around 20,000 bbl. daily, the fourth record in as many months. About 13,000 bbl. daily of this production came from Parentis field in southwestern France, operated by Esso Standard S.A.F. The crude came from seven producing wells. By the end of the year, output from the region may hit 22,000 bbl. daily.

In Sicily, development of Gulf Oil Corp.'s Ragusa field hiked Italian production to 5,100 bbl. daily in August, the seventh rise in 8 months. Intensive development work in Germany resulted in the seventh gain in a row there. Production reached 63,200 bbl. daily.

Turkish crude production has built up from 2,300 bbl. daily in January to 6,400 bbl. daily. Output comes from Ratman field in southeastern Turkey. It is operated by the government. Plans are under way to develop the field to supply crude for a 6,250-bbl. daily refinery to be completed this year.

TREND OVER THE LAST YEAR

	Western Hemisphere less U.S.	Middle East	Total non-Communist countries
1954—			
August	2,667.0	2,750.0	5,915.9
September	2,704.5	2,702.2	5,879.9
October	2,750.0	2,898.6	6,141.6
November	2,856.5	2,844.6	6,193.6
1955—			
December	2,975.7	3,001.8	6,453.3
January	3,001.5	2,950.1	6,442.5
February	3,050.4	3,109.3	6,663.8
March	3,036.0	3,247.9	6,775.8
April	2,981.6	3,327.6	6,805.9
May	2,932.1	3,287.4	6,718.8
June	3,019.7	3,201.6	6,720.9
July	3,092.7	3,275.8	6,872.1
August	3,146.8	3,243.0	6,963.6

CRUDE-OIL PRODUCTION

(Daily average in thousands of barrels)

Country—	August 1955	July 1955	August 1954
W. Hemisphere:			
Argentina	85.2	85.2	77.0
Bolivia	8.4	7.4	4.7
Brazil	5.5	5.5	2.6
Canada	376.0	399.6	294.8
Chile	7.5	6.9	4.5
Colombia	108.6	108.5	103.7
Cuba	1.2	1.2	0.1
Ecuador	10.0	10.0	8.6
Mexico	260.0	253.6	235.0
Peru	46.8	47.0	46.4
Trinidad	68.0	66.7	65.4
Venezuela	2,169.6	2,101.1	1,824.2
Total	3,146.8	3,092.7	2,667.0
Western Europe and Africa:			
Algeria	1.1	1.1	1.3
Austria*	67.0		
France	20.0	18.2	10.4
Fr. Morocco	2.0	2.0	2.5
W. Germany	63.2	62.7	53.3
Italy	5.1	4.4	1.4
Netherlands	19.4	19.1	18.5
Egypt	34.0	34.3	37.1
United Kingdom	1.2	1.2	1.2
Total	213.0	143.0	125.7
Middle East:			
Bahrain	30.1	30.0	30.3
Iran	354.0	348.0	30.6
Iraq	724.7	656.2	639.9
Kuwait	1,046.2	1,151.7	1,011.3
Neutral Zone	26.0	25.0	20.5
Qatar	115.4	116.1	97.1
Saudi Arabia	940.2	942.4	919.1
Turkey	6.4	6.4	1.2
Total	3,243.0	3,275.8	2,750.0
Other Asia:			
Brit. Borneo	99.0	99.9	98.7
Burma	3.7	3.7	3.5
India	7.5	7.5	7.0
Indonesia	230.0	230.0	240.0
Japan	6.4	6.2	5.7
New Guinea	8.8	8.8	12.9
Pakistan	5.4	5.4	5.4
Total	360.8	360.6	373.2
Total non-Communist foreign	6,963.6	6,872.1	5,915.9
United States	6,665.0	6,632.0	6,167.4
Total Free World	13,628.6	13,504.1	12,083.3
Communist-controlled countries:			
Russian occupation Zone of Austria*		57.5	62.0
Romania	125.0	125.0	110.0
Russia	1,260.0	1,260.0	1,160.0
Others	36.8	36.8	36.8
Total	1,421.8	1,479.3	1,368.8
World total	15,050.4	14,983.4	13,452.1

*Austria took over its producing fields from Russia on August 13. The production figures for August, listed with free world countries, is the level of output reported at the time of transfer. Figures for July 1955 and August 1954, listed with Communist Countries, are based on previous estimates.

Figures are from reliable reports in the industry of official government sources. Data for Russia and Eastern Europe are based on competent estimates; no authentic information is available on month-to-month production in these areas. Estimates also have been made for other countries, particularly in Southeast Asia, where completely current reports are lacking. Other Communist includes China and Yugoslavia as well as the Soviet satellite countries in Europe.

Cuban Test Spudded

Wildcat started by Cuban American near Jatibonico

CUBAN AMERICAN DRILLING & EXPLORATION CO. last week spudded in a second wildcat on its big concession in Cuba's Central basin area.

The new venture, the 1 Cristales, is about 5 miles northeast of Majagua in Camaguey Province. The location is about 10 miles east of Jatibonico field and about 5 miles southeast of the firm's first test, the 1 Adelaide. The company's concession covers more than a million acres.

Cuban American Drilling & Exploration, a stock company, is a subsidiary of Cuban American Oil Co., organized by Tevis F. Morrow, Los Angeles, and H. W. Klein and G. H. Vaughn, Jr., of Dallas in 1954.

The company obtained a 750,000-acre concession immediately following its formation from Trans-Cuba Oil Co. and Cuban-Venezuelan Oil Voting Trust. It pledged to put up $1,500,000 in risk capital and to drill 40,000 ft. of hole.

First wildcat . . . The 1 Adelaide was drilled to 5,280 ft. where it encountered serpentine rocks. The serpentine wasn't penetrated, and W. H. Cardwell, Cuban American chief geologist, said it wasn't known whether the test had hit basement or just a serpentine sill. A few noncommercial oil shows were logged.

Since this well was drilled Cuban American has traded the acreage it held in the eastern basin back to C.V.O.V.T. and Trans Cuba for more central basin lands. The company also has negotiated successfully with Clarence Moore, Havana, to take over concessions in the central basin and the Zapata basin to the west.

Cuban American has kept a seismic crew busy working its properties since late in the summer of 1954 and will move another into the country soon.

Projected depth . . . Cardwell said the new wildcat will drill until it runs out of good sediments, probably at around 6,000 to 7,000 ft. He added that the company hopes the project will prove to be higher structurally than the first test.

The 1 Cristales is being drilled by a rig and crew of Dixie Drilling Co., a Vaughn-Klein company with headquarters in Dallas.

Cuban-American is negotiating for drilling permits prior to spotting locations for its third and fourth Cuban wildcats.

WAPET Plans New Exploration

WESTERN AUSTRALIAN PETROLEUM PTY., LTD. (WAPET), has announced an exploration program involving more than $7,750,000 for 1956 on the 215,000 sq. miles in Western Australia it has under permit. That multimillion dollar budget is subject to upward revision in the event early tests prove encouraging.

Areas slated for extensive exploration include Rough Range, Salt Marsh, Giralia, Perth basin, Dampier Peninsula, Canning basin, Kimberly, and Cape Range. Search techniques to be used include seismograph surveys, shallow core drilling, aerial magnetometer, and gravity surveys.

Wildcatting in the Rough Range area will be held up pending final reports from detailed seismograph surveys started there in July. This decision to halt drilling was made on geological evidence from seven dry holes near the only successful completion in the country. Subsurface structures apparently do not coincide with exposed surface structures.

Exploration details . . . Shallow core tests are slated for the Salt Marsh area, including Dirk Hartog Island and other points along the coast. Three shallow core holes were drilled about 1,500 ft. deep at Grierson and a fourth was slated at Cape Cuvier.

One well has already been drilled in this area, a 5,992-ft. dry hole on a site 80 miles south of Rough Range. Information from this test, which failed to find any significant oil or gas showings, will be correlated with the shallow hole operations and geological and geophysical surveys of the region. The Giralia uplift is also scheduled to get a thorough geological and geophysical survey in 1956.

Despite an earlier deep test which had little gas or oil shows, the Kimberly Range is now undergoing exhaustive geological study. As soon as a number of known structures there have been evaluated, sites will be selected for further drilling.

Elsewhere, exploratory drilling is slated for the Fraser River area.

Refinery Plans Made

Finns buy materials from French, German companies

MATERIALS for the new 18,000-bbl. daily refinery to be built for Neste Oy, the Finnish Government company, will be furnished by French and German firms.

Lummus Co. will engineer and build the refinery near Turku. It will be the northernmost refinery in the world and is expected to supply about 70 per cent of Finland's domestic petroleum needs.

Neste Oy has signed contracts with Cie. de Vies-Lille for about 60 per cent of the materials for the refinery and with Mannesmann Rohrbau for the bulk of the remainder.

The $17-million refinery is expected to be completed some time in 1957. Capacities of individual units have not been revealed, but the balance of products will be in about the same proportion as in modern U. S. refineries.

Neste Oy will use the Thermofor catalytic cracking process licensed by Socony Mobil Oil Co., Inc., a Catformer licensed by Atlantic Refining Co., and California Research Co.'s polymerization process.

Original announcements of plans for the refinery said distribution of products is expected to be handled through existing marketing companies in Finland, but final agreements have not yet been reached. Last April, three western oil companies stopped marketing Romanian products thrugh their outlets (*The Oil and Gas Journal, April 11, page 98*).

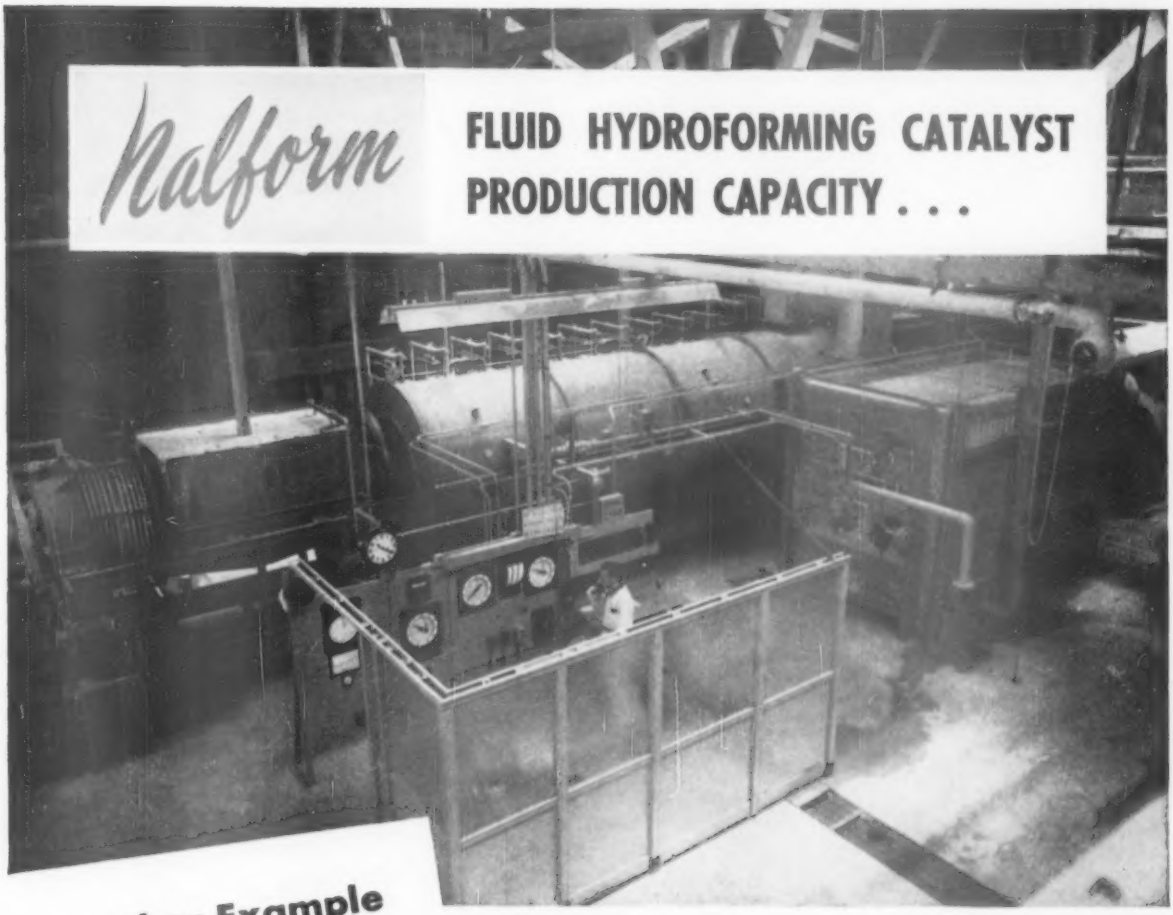
The three—Esso, Shell, and Gulf—distributed Romanian petroleum products for more than 2 years because Finland was short of western currencies. In April, Rudolf Bistroem, head of Finnish Esso Co., said the three companies had had enough. He said Finland's currency reserves were strong enough to resume purchases from the West.

International Briefs

A new "large" refinery will be built at Lanchow, in north-central China, according to an announcement made last week by the New China news agency. The agency did not give the size of the plant, but said it will produce aviation and motor gasoline, diesel fuels, and lube oils.

Edwin C. Pauley, Los Angeles independent oil operator, has signed an agreement for an exploration concession in Jordan. The 55-year contract is subject to ratification by the Jordan parliament. Pauley has 8 months in which to evaluate the 12,000,000-acre country's oil prospects. He then must select one-third for an exploration and development concession. Profits would be split 50-50.

Nalform **FLUID HYDROFORMING CATALYST PRODUCTION CAPACITY . . .**



another Example of Service to further Petroleum Industry Progress

● Fluid hydroforming to upgrade petroleum products is one of the typically rapid advances in the Petroleum Industry that the Nalco Catalyst Division is proud to have had a part in making possible.

Standard Oil Development Company and Nalco Catalyst Division worked together in developing Nalform Hydroforming Catalyst. In a surprisingly short time, Nalform was being produced in commercial quantities.

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Production and Service to Match Petroleum Industry Progress

CATALYST DIVISION – NATIONAL ALUMINATE CORPORATION
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GENERAL MANAGING DIRECTOR of the two consortium operating companies, L. E. J. Brouwer, center, presides at a board meeting of the refining company, Iranian Oil Refining Co. Brouwer was originally a geologist for the Royal Dutch-Shell group and later held top-level administrative jobs in the group. Left to right, are Paul Kuhl, general refinery manager, formerly of Standard Oil Co. (N.J.), Manouchehr Farman Farmavan, Brouwer, and Mamoud Poozeshi. The consortium has been operating the plant 1 year.

Iran—A Giant Unlimbering Its Muscles

Consortium is bringing this Middle East oil province back to the spot it occupied before nationalization.

Paul Swain

This is the first of a series of articles by the Journal's International Editor tracing the progress made in Iran since the consortium took over operations last year.

IRAN celebrated an anniversary last week. It was just a year ago, October 29, that the Shah affixed his seal to the agreement between the international oil consortium and the Iranian Government. That agreement started the Iranian oil industry on the road back to the place it once held in the world oil picture.

Last week Iranian Oil Participants, Ltd., the British-incorporated company which is owned by the consortium members, reported on the progress of the past year. The job of returning Iran to its 1950 status is far from complete, but it has been a year of achievements.

Here, in brief, is what has been done:

. . . **Production** in the first 11 months was 12,666,000 tons (an average of more than 286,000 bbl. daily for the entire period). Gross production rose steadily with few fluctuations the past year. It was 186,000 bbl. daily in November 1954 and an estimated 355,000 bbl. daily last month. It is expected to be 327,000 bbl. daily for 1955; 498,000 bbl. daily in 1956, and 637,000 bbl. daily in 1957. The 1957 production will put Iran just about where she was when the oil operations were nationalized more than 3 years ago.

. . . **Refining** operations have increased at a slower pace. The job of putting the mammoth 500,000-bbl. daily refinery at Abadan back on stream is a slow one. The Abadan refinery operated at slightly more than 102,000 bbl. daily, or about 20 per cent of capacity in November 1954. Last month this throughput had been increased to 158,000 bbl. daily as more units were overhauled and added. The refinery is expected to be operating at about two-thirds capacity by 1957.

. . . **Supporting services** to provide housing, hospitalization, water supplies, and other necessities of life for Iranian oil industry workers are being supplied by the industry on an interim basis. These functions will gradually be taken over by the National Iranian Oil Co. and municipal authorities. But, until the operating companies can be relieved of all but industrial operations directly related to production and refining, these services have to be supplied.

Housing is the major concern and an active building program is under way. By the end of next year, 800 houses will have been built for Abadan workers and another 425 will be built for workers in the oil fields.

Schools built by the operating companies have already been turned over to the Iranian Ministry of Education. All these social functions will gradually be shifted from the private oil industry to the national oil company and the government. But this will take "a long time."

Iranian Oil Participants is obviously a little proud of the record it is able to report for the first year's activity. It is the first detailed information to come out of Iran in the past year. The report should go a long way toward allaying any nationalistic fears on the part of the Iranians about what their country will get from its oil industry.

Iran received more than $74,760,000 from operation of its oil industry during the first 11 months of its renewed operation. The total income for Iran for the Persian year 1334 which ends next March will be more than $98,000,000, plus another $50,000,000 in for-

eign exchange brought into the country to meet operating expenses.

This annual income for the country will of course increase as production goes up. I.O.P. says a conservative estimate for the Persian year 1336, ending March 1958, is $187,600,000. This anticipated revenue from oil is just about equal to Iran's present annual budget.

These figures represent cash payments and the value of oil delivered to Iran instead of cash. Iran may take 12½ per cent of the production in oil and market it herself or she may elect to receive cash payment instead of the oil, based on posted prices per barrel.

How it's run . . . Under terms of the consortium agreement, two operating companies were set up to conduct Iran's oil industry, Iranian Oil Exploration & Producing Co. and Iranian Oil Refining Co. At the end of September, the two operating companies employed 49,079 men in the fields, Abadan, and the Teheran headquarters. All but 280 of them are Iranians. The I.O.P. report stresses the quality of its Iranian personnel. It says Iranians are assuming all levels of responsibility in both operating companies.

Both operating companies have seven-man boards and three members of each are Iranians. The companies have set up a training program both in Iran and abroad for Iranian personnel. About 50 members of the Iranian staff will be sent abroad for training in 1955 and 1956.

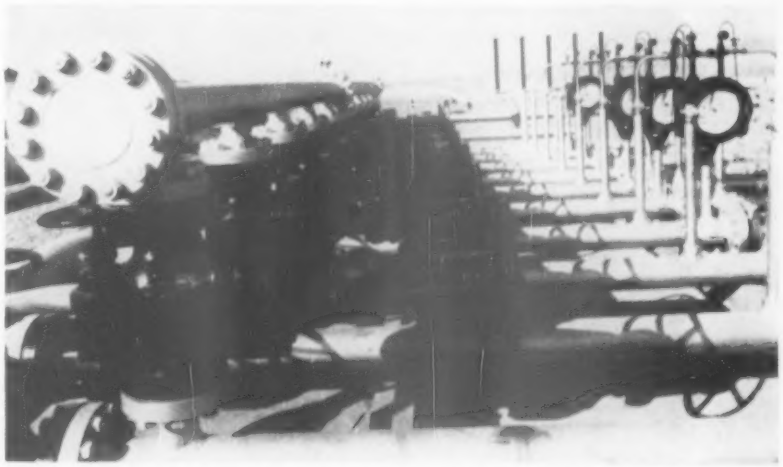
The foreign staff in Iran has expanded from the 80 in the October 1954 survey party to about 280 at the present time. This figure will probably total 400 to 500 before the entire job is completed. The figure is expected to decrease, however, as soon as Iranians are trained and qualified to perform more technical jobs. Most of the foreign personnel have been loaned by the participating companies, usually for a period of 2 years.

Here's a breakdown of nationalities at the end of the first year:

	Oil fields	Abadan	Teheran	Total
American	24	110	2	136
British	33	68	7	108
Dutch	4	26	4	34
French	1		1	2
	62	204	14	280

Iran's oil history . . . Iran was the first Middle East country to have an oil industry. The first producing well was drilled at Masjid-i-Sulaiman in the Bakhtiari hills about 150 miles inland from the top of the Persian Gulf in 1908. Other fields, all with large reservoirs and high initial gas pressure, were discovered along the Bakhtiari range in 1927, 1928, 1934, 1937, and 1938.

OVERHAULED CAT CRACKER at Abadan was one of the big jobs facing consortium personnel. Tom Best, a Texan, directed the work of 300 men who worked for 3 months to complete the job.



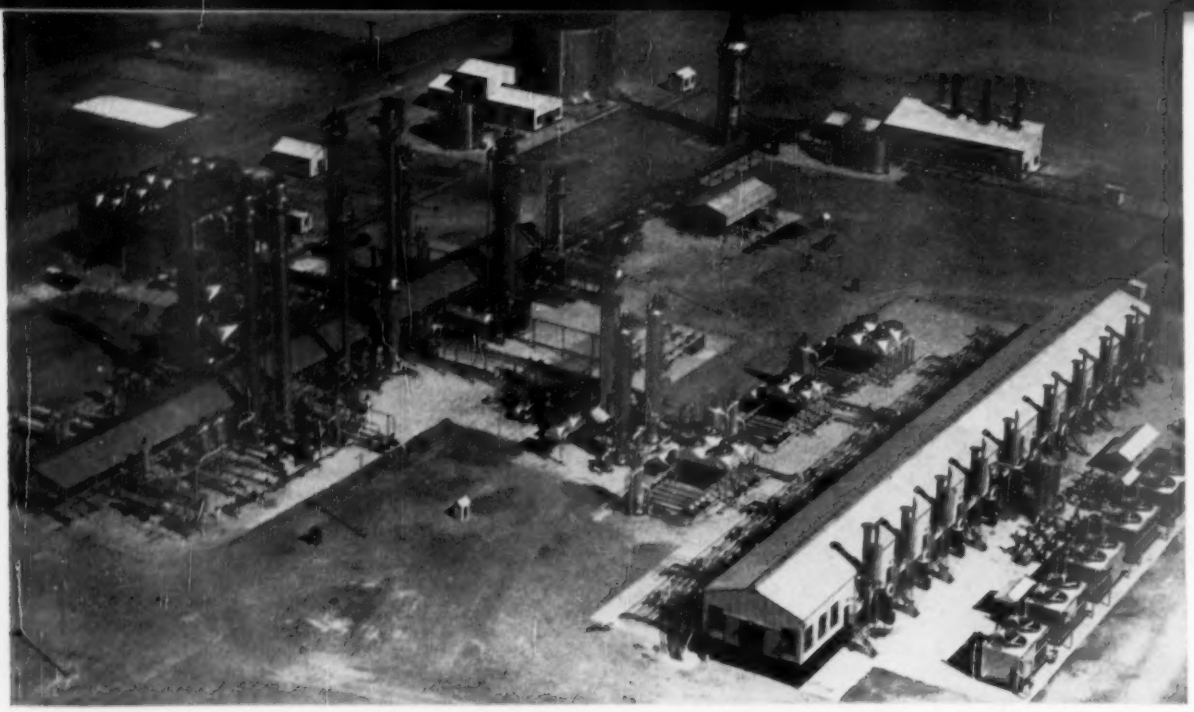
NEW MULTISTAGE STABILIZATION UNIT at Agha Jari field in southern Iran has increased the producing potential of the field by 50 per cent. The new unit went on stream in July.

Developed by the Anglo-Persian Oil Co., later Anglo-Iranian, the industry was operated by the British company until 1951 when it was nationalized. Then began a long period of negotiations before an agreement started the idle industry on the road back to production.

Present owners . . . The international consortium which reached the agreement with the Iranian Government is composed of five major American companies. Each holds a 7 per cent interest. They are Standard Oil Co. (N. J.), Gulf Oil Corp., The Texas Co., Standard Oil Co. of California, and Socony Mobil Oil Co., Inc. Nine additional American companies have a 5 per cent interest together. They are American Independent Oil Co., Atlantic Refining Co., Hancock Oil Co., Pacific Western Oil Corp., Richfield Oil Corp., San Jacinto Petroleum Corp., Signal Oil & Gas Co., Standard Oil Co. of Ohio, and Tide Water Associated Oil Co.

British Petroleum Co., formerly Anglo-Iranian, holds a 40 per cent interest, N.V. De Bataafsche Petroleum Maatschappij (Royal Dutch-Shell) holds 14 per cent, and Compagnie Francaise des Petroles has the remaining 6 per cent interest.

Under terms of the consortium agreement, the two operating companies in Iran deliver to National Iranian Oil Co. the products needed for internal consumption in Iran, in addition to the 12½ per cent crude or cash equivalent payment. The remaining crude and products are taken by trading companies formed by the participating companies.



MAGNOLIA-OPERATED Pegasus plant, located 30 miles southwest of Midland, Tex., processes 71,000 M.c.f.d. plus some condensate

PEGASUS PLANT PROVES PLANNING PAYS

How to Grow Without Growing Pains

Magnolia operates modern processing plant for owner-group; step-by-step growth accomplished with adoption of features designed for streamlined operations; water consumption minimized in semiarid West Texas locality.

by F. Lawrence Resen
District Editor

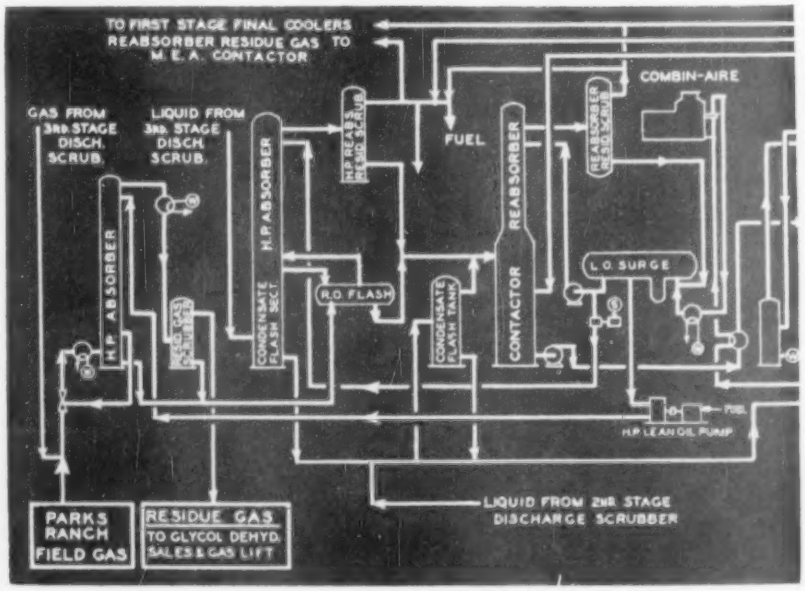
STEP-BY-STEP growth backed by long-range planning. That's what it took to make the Pegasus installations into a streamlined natural-gasoline-plant operation.

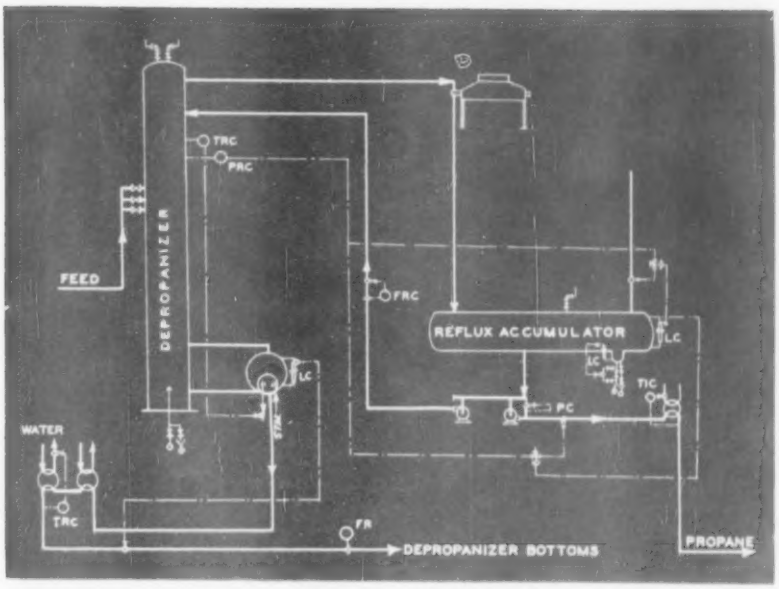
The plant evolved into a full-fledged field processing unit from a humble beginning as a simple compressor installation. A master plan was followed which anticipated future requirements. This lent stability to the over-all program and allowed the incorporation of features to make a highly efficient, modern plant.

The Pegasus plant, located about 30 miles southwest of Midland, Tex., is operated by Magnolia Petroleum Co., one of several owners. Other owners include Aurora Gasoline Co., Republic Natural Gas Co., Spartan Drilling Co., Sharples Oil Corp., Gustave Ring, and M. T. Halbouty. The plant was designed by Magnolia's natural-gas department engineers and constructed by Hudson Engineering Co.

Under present conditions the plant receives about 71 M.M.c.f. of gas, plus 23,000 gal. of condensate from a field compressor station, and receives 207,000 gal. of liquid products daily, of which 91,000 is gasoline.

Features . . . Engineeringwise, the plant contains a number of interesting features. These include:





DEPROPANIZER INSTRUMENTATION is of interest. Flooded condenser bundle principle is employed.

Water cooling system: Use of air-cooling extensively and a combination air and water cooling tower have held water makeup requirements to an exceptionally low figure—average of 40-45 g.p.m. This is a critical factor in the water-starved Southwest.

Instrumentation: High degree of instrumentation is used in plant, including extensive process alarm system. Temperature controls are widely used as part of the water cooling system, to conserve demands on cooling tower.

Segregated flow: Heavy stock is segregated in the plant process so that a lighter distillation load is effected.

Elimination of high-pressure pumps: In two main absorbers, rich oil is circulated into incoming gas stream before it enters absorber. Venturi restrictions are built into gas piping at this point, and pressure differential caused by gas flow circulates oil without need for separate pumps.

Process flow . . . Process gas enters the plant in three separate streams. One is a 10½-M.M.c.f. stream from the Parks Ranch field booster station which doesn't require treating and directly enters the main absorber charge stream following separation from the stream condensate.

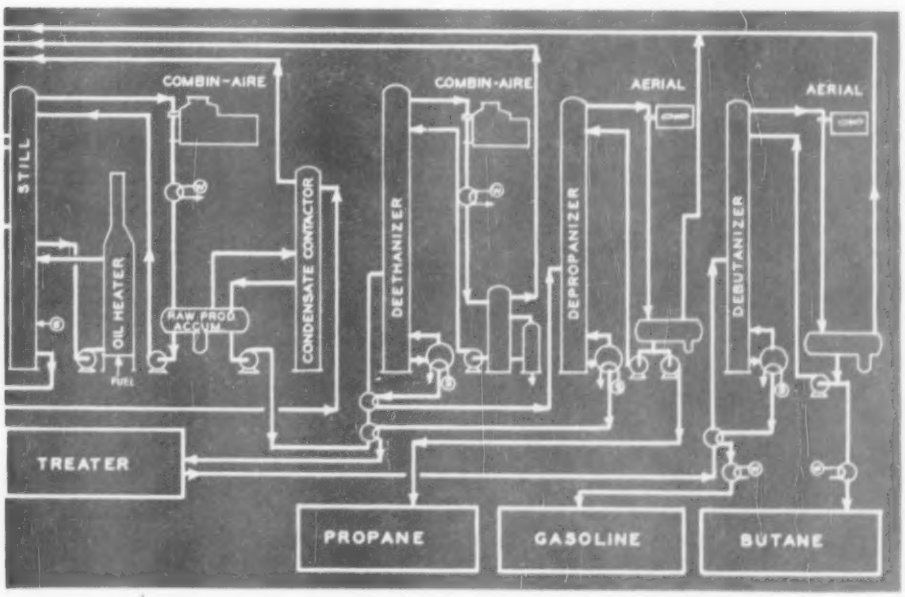
The other two streams—26½ M.M.c.f. at about atmospheric pressure and 34 M.M.c.f. at high pressure—initially have to pass through a monoethanolamine treater (not shown in flow sheet) before entering the process system. This gas is obtained from crude-oil separators handling production primarily from Ellenburger and Pennsylvania formations of Pegasus field.

The low-pressure gas is compressed to about 250-300 psig. and then blended with high-pressure gas from the field. This combined stream is charged to the MEA contactor where acid gases are removed. Following this, the gas stream is compressed to about 900 psig. and serves as the main charge to the absorbers. Two of these towers are now in the plant and operate in parallel.

Venturi flow . . . In the operation of the absorber, a rich-oil stream is pulled off from the base of the tower and circulated into the incoming inlet gas. The two streams are cooled while flowing concurrently through the absorber base cooler. This mixing and cooling of the rich-oil and inlet gas prior to entry into the absorber gives a substantial liquid-product recovery at the lowest temperatures obtainable with available cooling water. Thus, absorber heat rise due to vapor condensation is reduced and a favorable low temperature for rich-oil leaving the 900-psig. recovery level is obtained. A temperature controller is provided here to restrict flow of water to the absorber base cooler when there is a danger of gas-hydrate formation.

In circulating the rich oil into the incoming stream, an ingenious method has been used to eliminate high-pressure pumps. A venturi restriction is installed on the main gas line. The rich-oil line is attached at the restriction, and the pressure differential caused by the flow of gas is sufficient to cause rich oil to flow from the absorber into the gas stream. Savings are effected in equipment investment and pump-maintenance problems naturally, are nonexistent.

A separation section is provided in the base of the high-pressure absorber for separation of rich oil from the main gas stream. Gas from the separation section enters the 34-tray absorber section where it is contacted countercurrently with the



SPECIAL FEATURES of the Pegasus plant are: extensive use of air cooling, segregated flow of heavy stock to lighten distillation load, and use of a venturi to circulate rich oil to the base of the absorber with incoming gas.

lean absorption-oil stream. Stripped gas overhead is cooled, scrubbed, dehydrated, and enters the sales line. Rich oil from the bottom section of the absorbers is flashed into the rich-oil tank at high-pressure reabsorber pressure—250 psi.

Reabsorber . . . An interesting arrangement exists in the high-pressure reabsorber. In effect it serves as a dual tower. In the lower part is a condensate flash section where liquid from the 900-psig. third-stage compressor discharge scrubber is flashed. The heavy liquid does not come into contact with the rich-oil stream and is segregated from the distillation step. This lowers the still requirements at the plant and makes it possible to operate with just one distillation column.

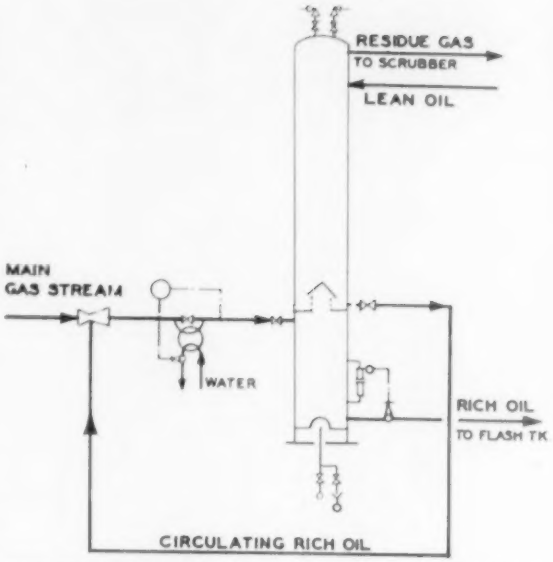
In addition to condensate vapors rising in the reabsorber, flash vapors from the rich-oil flash tank are charged to the base of the reabsorber section. These vapors are contacted with a metered volume of lean absorption oil in the 31-tray section. Rich oil from the reabsorber joins the flash-tank rich oil. This mixed oil stream is then pressured into the contactor-reabsorber which operates at 90 psig.

Flash condensate from the flash section of the base of the high-pressure reabsorber joins second-stage discharge scrubber condensate. This mixed stream flows to the condensate flash tank which operates at 115 psig. Vapors from the condensate flash tank are pressured into the contactor-reabsorber. Liquid from the condensate flash tank flows to the top tray of the condensate contactor.

Contactor-reabsorber . . . This vessel has a large 10-tray contactor section as a base and a smaller-diameter 30-tray reabsorber section mounted above it. The contactor provides a countercurrent contact between the main rich-oil stream and rich vapors from the condensate contactor. Undesirable gas fractions — methane and ethane — are stripped out of the rich oil entering the contactor section. These are replaced in a vapor-pressure relationship with desirable heavier fractions — C_3 and C_4—which are present in vapors from the condensate contactor.

Flashed vapors from the incoming rich oil, condensate flash tank vapors and vapors from the contactor section make up the gas feed to the 30-tray reabsorber section of this tower. These vapors are contacted with a lean-oil stream for final recovery of desirable components. Residue gas is scrubbed and made available for plant fuel.

Lean-oil flow to the reabsorber is controlled by a proportional controller which maintains a fixed ratio between the reabsorber residue gas volume and the lean-oil rate. This control is to assure a residue gas of fairly constant heating value. This is because the reabsorber residue is a principal source of plant fuel. Rich oil from the base of the contactor section is pumped through rich oil-lean oil exchangers to the feed tray in the still.



HOW RICH OIL is recirculated to base of absorber with incoming gas through venturi.

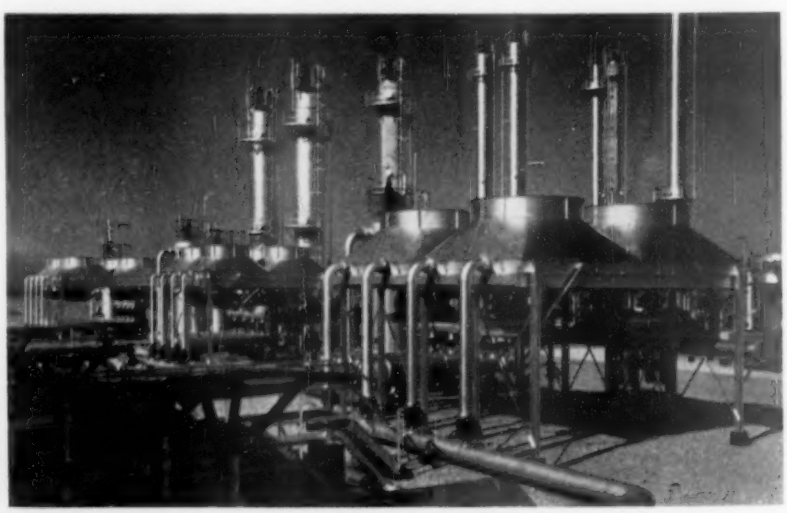
Distillation . . . In the 25-tray still, heat and stripping steam are used to remove absorbed products contained in the rich oil. A portion of the condensate from still overhead product is returned as reflux to the top tray to prevent an excessive loss of absorption oil in still vapors.

Rich-oil feed is heated and partially vaporized in the exchangers and after flashing on the feed tray flows down the still to a drawoff tray. Liquid accumulation on this tray is pumped to the oil heater. Additional vaporization takes place with the oil heated to about 525° F. The hot stream from the heater is returned to the bottom section of the still where light fractions remaining in the oil are removed by stripping with live steam.

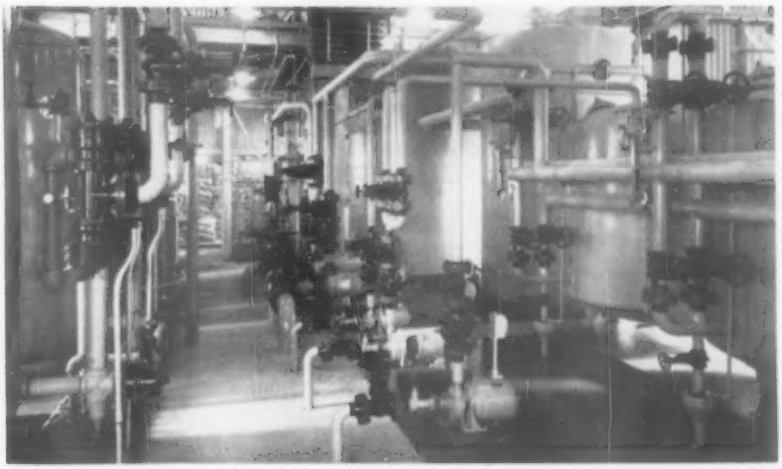
Instrumentation plays an important part here also. Rate-of-flow controllers are used to control the volume of stripping steam entering the base of the still and the volume of reflux. With this control, temperature of the still overhead will vary as composition of the rich-oil feed to the still changes. Variation in still top temperature may be considerable as weather and other field conditions change the incoming gas composition.

At the heater a temperature control is provided to maintain a set temperature on the oil leaving the heater by regulating the flow of gas to the heater. Flow indicators are installed on oil leads to the heater and are used in equalizing flow of oil to the two tube sections in the heater.

The stripped lean oil is first cooled



CONSERVATION OF WATER rates high at the Pegasus plant. Air-cooled units are used extensively along with a combination air and water cooling tower to hold water requirements to low 40-45 g.p.m. makeup.



WATER TREATING PLANT is necessary to treat raw water obtained from deep wells.

in exchangers and air coolers with final cooling in a water cooler prior to entering the surge tank. It is usually desirable to cool this as low as possible with available cooling water and hence no temperature control.

Still overhead products likewise are desired as cool as possible under cooling-water circulation and no temperature control is installed on this line. The vapors are partially condensed in air and water-cooled condensers and flow into the raw-product accumulator. This horizontal drum has a divider plate separating it into two sections. Liquid from the still-condensate section of the accumulator is drawn off for reflux to the top tray of the still. A water leg is also provided in this section for removal of steam condensate recovered from the overhead vapors of the still. Excess liquid products and uncondensed vapors flow over the divider plate into the raw-feed gasoline section of the accumulator. Uncondensed vapors from here flow to the base of the condensate contactor. Partially stabilized condensate from the contactor flows by gravity to the raw-feed section of the accumulator.

Condensate contactor . . . A 10-tray contact is provided between flashed compression condensate and uncondensed still vapors by the condensate contactor. In this way, part of the undesirable light fractions in the condensate are stripped out and replaced with desirable heavier fractions contained in the still vapors. Vapors from the condensate contactor flow to the base of the contactor-reabsorber while liquid flows to the raw-product accumulator as noted. This accumulator serves also as surge tank from where feed is withdrawn to charge the fractionation section of the plant.

Deethanizer control . . . Raw gasoline is pumped from the accumulator at a controlled rate through two preheating feed-to-bottom exchangers into the 24-tray deethanizer. To maintain correct separation in the tower the following control system has been installed: A rate-of-flow control fixes the steam flow rate to the deethanizer reboiler. The setting is automatically reset by a temperature controller taking response from an element located in the upper section of the deethanizer. A level control on the deethanizer reflux accumulator varies the reflux rate to maintain level in the accumulator. A pressure controller maintains column pressure by operating the pressure-control valve which handles uncondensed vapors from the reflux accumulator.

A minimum temperature control is used on the overhead product stream. Overhead vapors are condensed by cooling with air and then water. In general it is desired to cool this stream to as low a temperature as possible with available cooling water to minimize propane losses in the vapors. However, since there is a possibility that the water temperature may sometimes be low enough to cause the formation of hydrates in the overhead vapor line, a temperature controller is installed to restrict water circulation to the coolers when the cooler outlet temperature is at a safe minimum.

Depropanizer control . . . An interesting control system is used on the 30-tray depropanizer which receives its charge from the bottom of the deethanizer. To control the separation here, a temperature control to take response from a tray in the upper section of the tower is provided to regulate steam flow to the reboiler. A rate-of-flow controller in the reflux line maintains a satisfactory reflux rate.

Depropanizer overhead vapors are normally totally condensed in an air-cooled condenser. Pressure on the column is maintained by drawing off liquid propane at rates necessary to maintain the correct liquid backup in the reflux accumulator and part of the condenser tubes. If pressure in the column increases, the pressure-control valve is opened to allow more of the condenser tubes to be uncovered. With additional effective condenser surface, the temperature in the condenser is reduced, thereby reducing column pressure.

Decreasing column pressure will result in a reduced product flow from the accumulator. This will cause liquid level in the accumulator to build up and block some of the effective condensing surface. This action will cause the condenser temperature and column pressure to increase.

If overhead vapors from the depropanizer do not totally condense, the pressure on the column will increase. This will cause the pressure-control valve in the propane line to open up until a liquid level appears in the depropanizer reflux accumulator. In this event, a level controller on the accumulator will switch the pressure control air output from the motor valve in the propane products line to a motor valve in the vapor line from the accumulator and close the propane product line. This will continue until overhead vapors again totally condense. As the reflux accumulator refills, the level controller will change the pressure-control response back to the propane products line and close the accumulator vapor line.

Propane product from the accumulator is pumped through a product cooler to treating and dehydration facilities. Butane-gasoline bottoms from the depropanizer are cooled and then charged to a sweetening unit. From here, the mixture flows to the feed tray of the 36-tray debutanizer. This column has a similar pressure-control setup tied in with the accumulator and condenser liquid levels, as in the case of the depropanizer. Overhead butane and bottoms gasoline are cooled and charged to storage.

Propane sweetener . . . In the propane treating step, care is exercised to avoid contaminating the desiccant which dries the propane. Propane is initially pumped from the depropanizer reflux accumulator to a caustic wash system for removal of hydrogen sulfide.

The entering propane feed stream and recirculating caustic stream are mixed together in a nozzle. This mixture then flows to a caustic settler from where caustic is drained off the bottom. Treated propane product flows from the top of the settler into the top of the coalescer tank. Sweet propane

is removed from side of the coalescer. Any entrained caustic accumulates in the base of the coalescer.

Propane product from caustic treating is saturated with water. This is dried by passing through a solid-desiccant bed and then going to storage. In regenerating the dehydrator — two are installed—a sidestream of wet propane—containing no ethane or other undesirables—is used rather than a residue gas stream, or other means.

Cooling facilities . . . The chronic water shortage in West Texas dictated a need for an extensive system of temperature controllers to limit demands on the cooling tower. In addition to these, a considerable number of atmospheric coolers were installed where water cooling was not necessary, and finally a new-type "Combinaire" cooling tower developed by Hudson Engineering was installed. The combination was so successful that average water make-up runs about 40-45 g.p.m., for all services including boiler-feed makeup.

The cooling tower is a combination air-and-water cooling unit. The cooling water is circulated through various water coolers throughout the plant and returned to the top of the water-cooling section of the tower.

Air leaving the water section of the tower will usually be at a lower temperature than ambient air. This cool air is a favorable and additional medium for air cooling of streams which flow through air coolers in the air section of the tower. A number of services use air from the cooling tower for primary cooling with aftercooling performed with cooling water from the basin of the tower. The coolers and condensers installed in the air section are:

1. Primary still condenser.
2. Primary oil coolers.
3. Primary deethanizer condenser.

Cooling water from the tower is circulated through a shell-and-tube or hairpin coolers for cooling services which cannot be economically handled by air. These are:

1. Secondary deethanizer condenser.*
2. Depropanizer bottoms cooler.*
3. Secondary still condenser.
4. Secondary lean-oil cooler.
5. Absorber base cooler.*
6. Absorber after cooler*
7. Glycol cooling.
8. Gasoline product cooling.*
9. Butane product cooling.*
10. Propane dryer regenerator gas cooler.
11. Propane product cooler.*
12. First-stge final gas cooler.*
13. Second-stage final gas cooler.*
14. Third-stage final gas cooler.*
15. Amine cooler.

*Temperature controlled to regulate water flow.

The asterisks indicate the effort made to lower demands on cooling tower water through use of temperature controllers. As noted in the text, these are used both to prevent unnecessary overcooling which would waste cooling water by increasing cooling-tower evaporative losses and to prevent hydrate formation in some coolers.

Treating . . . Raw water obtained from deep wells requires considerable treatment to make it suitable for plant use. Incoming raw water enters a storage tank from which suction is taken into an accelator unit. A direct drawoff from the storage tank is provided for the plant fire system.

The water is treated with lime and soda in the accelator. Sludge knocked out from the water is pulled off the bottom of the accelator and treated water is carried over into the treater surge tank. From here it passes through filters where remaining free solids are removed. These are cake-type filters and are provided with usual backwash facilities.

Clear water from the filters next flows through a zeolite softener where additional treatment for removal of scale-forming compounds takes place. These treatments remove practically all of the hard scale-forming materials contained in the raw water and make it possible to carry a high concentration of dissolved solids in the cooling-water system without danger of serious scale troubles. Soft treated water is then stored in a tank from where makeup water to the cooling tower and boiler feed is withdrawn, as well as water for other plant facilities.

Step by step . . . Under present conditions, the plant has 10 compressors handling field gas plus some gas for gas lift. As was originally noted, the initial installation consisted of five 1,100-hp. compressors. Field separator gas was stepped up to pipeline pressures and sold, and condensate knocked out of the gas in compressor stages was also sold as such.

The next installation included the main process area capable of handling all of the gas available at that time. Part of this gas was returned to the field for gas-lift purposes. As requirements went up, five more compressors were added to the plant. Four were rated at 1,100-hp. and the fifth at 1,350-hp. The second main absorber was added to handle the increased gas flow as was a second amine contactor and additional generator capacity.

In the fourth phase of expansion, a pilot injection system was installed in the field and part of the compressor facilities were used to include a fourth and fifth stage gas at 3,600-4,600 psig. for this injection. Generation capacity was also increased with an additional generator. The final step to date has been the installation of a 3,300-hp. compressor station in Parks Ranch field. This boosts pressure of field gas, which is then recombined with condensate knocked out in the compression stages. The stream is piped to the Pegasus plant, the condensate separated, and the gas—which doesn't need treating—charged into the main absorber stream.

Thus, the Pegasus plant has evolved from a simple field compressor station into an expanded gasoline plant.

Acknowledgment

The cooperation of Magnolia Petroleum Co., plant operator, and the plant owners in the release of this information is gratefully acknowledged. Also the assistance rendered by V. L. Dickinson, district superintendent; M. E. Alford, district engineer; and A. B. Washington, plant engineer, Magnolia Petroleum Co.

NELSON REFINERY CONSTRUCTION INDEX

Appears in the Engineering Section in the first issue of each month.
Compiled by W. L. Nelson, petroleum refinery consultant, Tulsa.

The index was explained July 7, 1952, (page 105) as well as the Indexes of Individual Items of Equipment that appear on the Cost-imating page in the first issues of the months of January, April, July, and October.

	Index (1946 = 100)					
	1948	1950	1952	1953	1954	July 1955
Pumps, compressors, etc.	127.0	138.2	155.6	162.5	166.5	170.4
Electrical machinery	127.6	134.9	152.4	156.4	160.0	160.5
Internal-combustion engines	116.9	126.0	146.5	148.1	150.5	149.9
Instruments	120.0	127.8	146.2	151.8	154.6	162.9
Heat exchangers	130.0	140.0	165.8	174.9	171.7	156.2
Miscellaneous equipment average	*122.1	*126.2	153.3	158.8	160.7	160.0
Materials component	139.3	149.5	164.3	172.4	174.6	177.8
Labor component	128.0	144.0	163.1	174.2	183.3	190.3
Nelson construction index	132.5	146.2	163.6	173.5	179.8	185.3

*Used in computing the Nelson Index until April 1952. These are slightly different from the average of the Miscellaneous Equipment Items shown above.

Is the U.S. Lagging Behind Russia in TURBODRILL DEVELOPMENT?

Let's have a look at the situation in both countries

BUT FIRST . . .

What is the turbodrill? . . . It is a mud-powered cylindrical turbine on the end of a string of drill pipe. Mud, pumped down the pipe, flows through the vanes of the turbine, and turns a shaft which drives a conventional rotary bit. The amount of power developed depends directly on the amount of mud pressure that is converted to mechanical energy in the turbine.

What does it do? . . . One of the main features of the turbodrill is to produce rotary power to the drilling bit without rotation of the drill pipe. The advantages of producing the rotary power by this means are: (1) to reduce drill pipe torsion, wear, and failure and (2) to allow a large amount of power to be imparted to the bit.

Active turbodrill development started both in America and in Russia about 15 years ago and continued along parallel lines until World War II. Since that time, very little American development has been done. But in Russia, the method has been widely used industrially. Turbodrilling is now the predominant drilling method in Russia.

In this two-part article you can see how turbodrill development has lagged in America. You can also see what the Russians have done to produce improved equipment which has achieved remarkable drilling records. If these Russian achievements are as outstanding as they claim, is not the American drilling industry missing a good bet in the turbodrill? This is a question which drilling people could well afford to answer.

1. The U.S. . . . Idea Not New but Progress Has Been Slow

by W. R. Postlewaite

SINCE the first engineering work in turbine-powered drills (commonly known as turbodrills) more than 30 years ago, designs have continually improved. Designs are now available which could make the use of the turbodrill competitive with rotary drilling. Further work is required before a successful turbodrill can be made available for general use, however. Principally this work should include:

. . . Development of small-diameter turbines to fit present drill-hole programs.

. . . Incorporation of improved design, long-lasting thrust, and radial guide bearings in the turbine and drill shaft.

. . . Widening the range of rotational speeds.

. . . Completion of tests of a rotary speed indicator.

Faster drilling in the future . . . The most recent drilling tests of the turbodrill show that it can be used to drill as fast as rotary drilling. However, competitive operation has been delayed by equipment inadequacies and by the need to explore various design features.

Author is mechanical engineer with Standard Oil Co. of California. Material presented at A.S.M.E. petroleum mechanical engineering conference, New Orleans.

One of the prime advantages of the turbine over the rotary is its stationary drill pipe and the obvious lighter duty imposed on this pipe as a result. Work has showed that the turbodrill turns faster than the rotary can safely be turned and has an abundance of power available at the bit. This offers the prospect of materially increasing drilling rates. The feature of automatic stalling at high torque also gives the turbodrill an advantage in deep drilling.

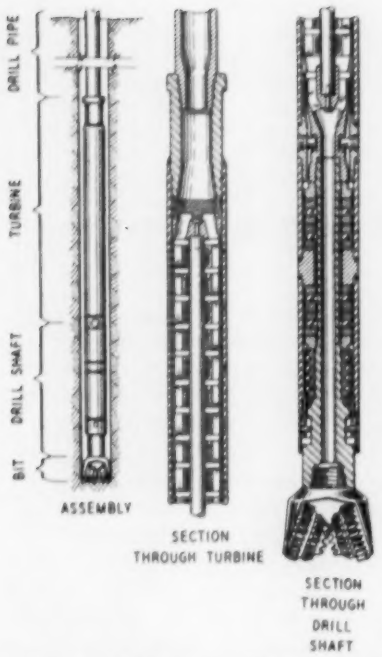
In order to stimulate interest in further development of mud-powered turbines, this paper reviews the past progress and points out the areas of needed future work.

Lower-cost drilling . . . Early turbodrill designs employed bearing seals on the shafts which invariably leaked and as a result were rapidly cut out by the drilling mud. Although these tools were not sufficiently durable to be commercially usable, they demonstrated the general mechanical possibilities of this device.

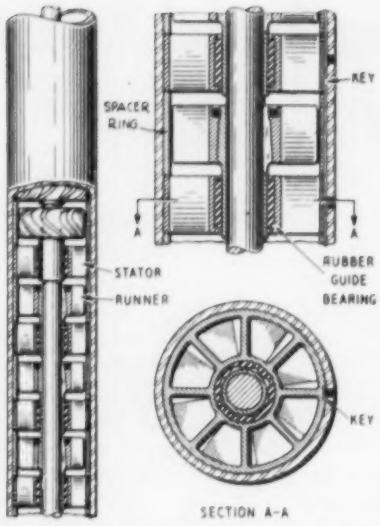
No great expectation of increased drilling rate was held, but it was estimated that with equal drilling rates the drilling cost with a turbine driving the bit would be $6,000 to $10,000 less per well than with usual rotary methods. These savings would be realized because depreciation of the drilling equipment would be less with the turbodrill.

Drill pipe constitutes a pertinent expense item in drilling. For example, the average annual replacement expense for drill pipe in Standard Oil Co. of California's operations, in the 5 years of 1936-1940, was 43 per cent of the total expense for replacement of all drilling equipment. Drill-pipe cost during this period was $300,000 per year, compared to $397,000 per year for all other drilling equipment combined.

Where turbo saves power . . . It may be of interest to review some of the reasons why the turbodrill is expected to operate at a lower cost than conventional equipment. It must be understood that, particularly in the deeper wells, nearly all the power now applied



HOW the turbodrill is assembled. As many as 50 stages have been built into the turbine. Fig. 1.



VANES fit hub to hub. Rotating shaft is guided by rubber bearings on the stator vanes. Fig. 2.

by the rotary table at the surface is wasted in friction between the pipe and the mud circulating fluid, and against the side of the hole. Only a small fraction, perhaps 10 per cent, is actually applied effectively to the bit.

Various experiments have indicated that in deep holes, from 10 to 25 hp. is required to turn the bit, although the rotary drive may have to deliver several hundred horsepower. The rotary drill pipe is subjected to considerable wear from friction against the side of the hole, and from heavy loads, largely due to its great flexibility which permits it to wind up and violently unwind as the resistance changes.

With the turbodrill the string of drill pipe must, of course, still take the actual net effort applied to the bit, even with the pipe stationary. But as this torque may be on the order of but 10 per cent of the effort applied at the top with conventional equipment, the drastic reduction in shock loads, reverse stress, and friction load should lighten the duty on the drill pipe tremendously.

Lighter drill pipe and simpler tool joints can be used, promising much longer pipe life and greater freedom from failure at a considerable saving in cost. It also becomes practicable to use pipe of larger diameter, thus minimizing the pressure required on the circulating pumps. Protective collars on the pipe likewise would not be needed.

The mechanical efficiency of present turbines is only on the order of 50 per cent and the mud pressure may have to be increased several hundred psi. to operate the turbine. But the over-all pumping power required should, with a properly designed and balanced installation, probably be less or no more than with conventional equipment.

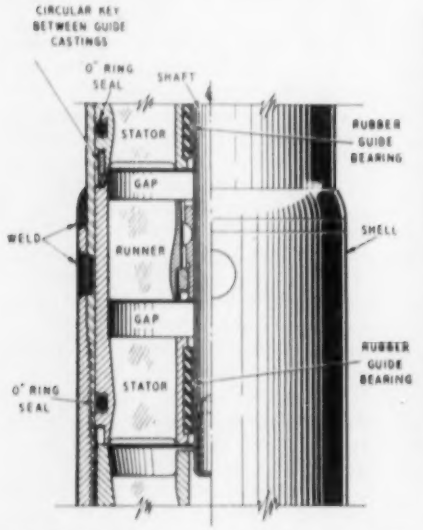
Development of designs . . . Much of the progress in turbodrill design was made in the years 1935-1941 and 1949-1950 by the joint effort of the Standard Oil Co. of California and the A. O. Smith Co., of Milwaukee. The long flexible multistage turbine-runner shaft, originally guided only by bearings at each end, whipped badly in the earliest models. This was replaced by the present improved design having a separate radial guide bearing at each individual turbine stage.

Pertinent features of the turbodrill design is shown in Figs. 1, 2, 3, and 4, which illustrate the principal elements of the device. The turbine-runner bearings of these models are of the conventional fluted-rubber sleeve type used on marine propeller shafts and on the rotor shafts of sand dredges. In the turbodrill they run directly in the drilling fluid which serves as a lubricant.

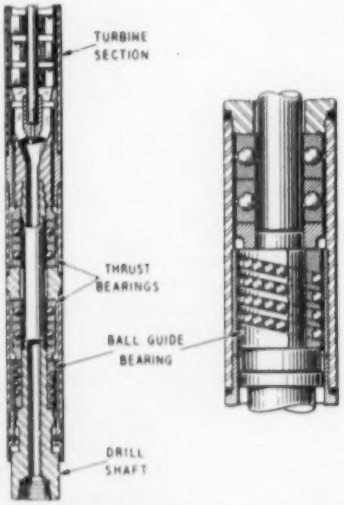
This multiple-bearing arrangement completely stabilizes the long turbine shaft and permits using any number of stages in the turbine assembly. In this way any amount of power desired at any reasonable rotation rate and mud circulation rate can be obtained.

As many as 50 stages have been built in 9⅝-in. turbines although 30 or even 20 stages have proved adequate as regards torque and power requirements for most drilling. Methods of assembly have been worked out which permit worn turbine parts to be replaced expeditiously, and permit the maintenance of proper axial clearance of the runners at all times.

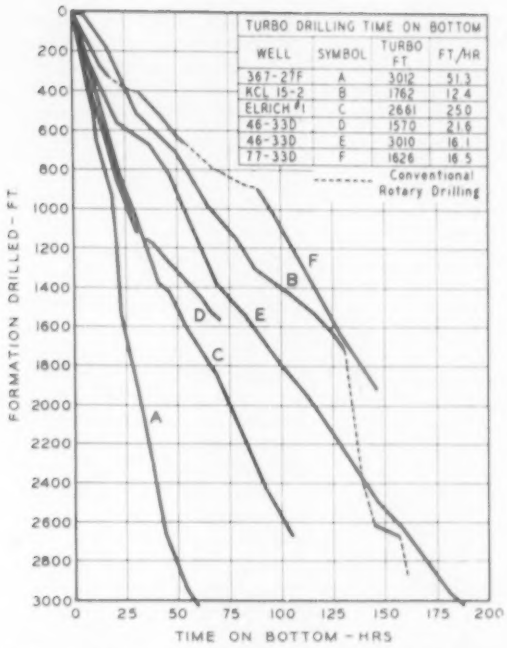
Thrust bearings . . . Another new design, evolved after exhaustive laboratory and field tests, was to expose the turbine thrust bearings directly to the drilling mud. No way has been found to exclude the mud from oil-lubricated bearings. Large-diameter ball thrust bearings shown in Fig. 4 have been found to be reasonably satisfactory for this service. With thrust loadings used up to 1941, these bearings



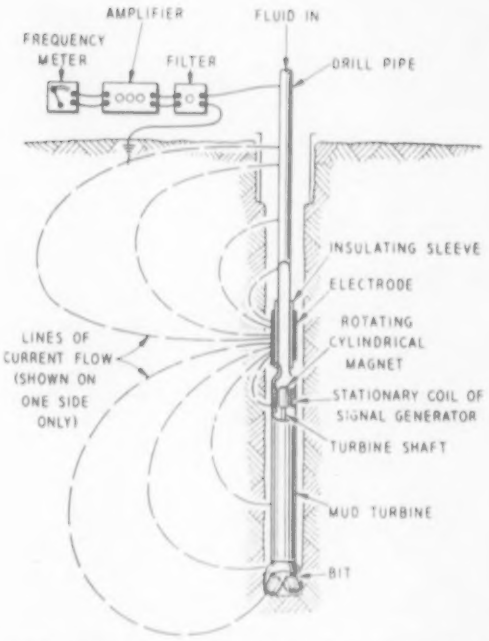
TURBINE detail shows seal used to prevent mud channeling between shell and stator castings. Fig. 3.



BALL BEARING guide for guide shaft is inclined to reduce concentrated wear of the race. Fig. 4.



FIELD DRILLING performance in California wells. Latest results are 1950 test shown by curve A. Present rotary rates are as fast as this, however. Fig. 5.



SPEED INDICATOR for turbine shaft is an a.c. generator. Current is picked up at surface where frequency is converted to r.p.m. Fig. 6.

worked well and operated for more than 100 hours without breakage.

Subsequent tests at heavier thrust loads reveal the need to either provide greater bearing capacity or to balance hydraulically part of the thrust of the turbine. Alternate designs have been made of "three-stage" ball bearings. Here the thrust load would divide evenly between three separate tandem bearing assemblies by means of suitably resilient cushion mounts. Bearing balls similar to those developed for cone bits would be very well suited for thrust service on the turbodrill.

Experience to date indicates that heavy thrust loads, on the order of 20,000 to 30,000 lb. in the 9-in. turbine, can best be carried by a combination of a hydraulic balancing piston and multiple rubber thrust bearings. These are shown in U. S. Patents 2592519 and 2613917. The high rubbing velocity suited to these rubber bearings is characteristic of the turbo, and drilling mud is a good lubricant for this service.

Stator and rotor . . . One basic principle which has enabled this reaction type of turbine to operate successfully on abrasive-laden drilling fluid is proportioning the fluid passages to minimize the jetting velocity. The stationary vaned guide castings, and the bladed runners of each stage, are made of conventional nickel iron, but the durability of these parts has been satisfactory. Turbines designed by others which have employed high mud velocities have suffered heavy maintenance and wear.

The turbine runners are clamped securely to the turbine shaft by the unique tapered and split-collet hub assembly shown in Fig. 2. To prevent wear of the long central runner shaft in the rubber guide bearings, the lower sleeve end of the replaceable runner hub clamp is used as the journal for the next lower guide bearing. The outside of this journal section is protected by a hard chrome plating which runs very well in the fluted-rubber guide bearings.

The axial flutes or channels in these rubber bearings allow fluid to circulate freely. When sand particles are engaged between the mating surfaces, the flexibility of the rubber enables the particles to roll circumferentially to the next axial flute where they are washed on through.

As shown in Fig. 1 the stationary guide-vane castings now have double-length extension skirts which completely shroud the adjacent runner castings. These have replaced the separate outer spacer rings shown in Fig. 2 and have reduced the joints. This presents a continuous sleeve of hard nickel iron right at the bottom of the runner wheel where the exit velocity of the mud is high, and where erosion otherwise might occur.

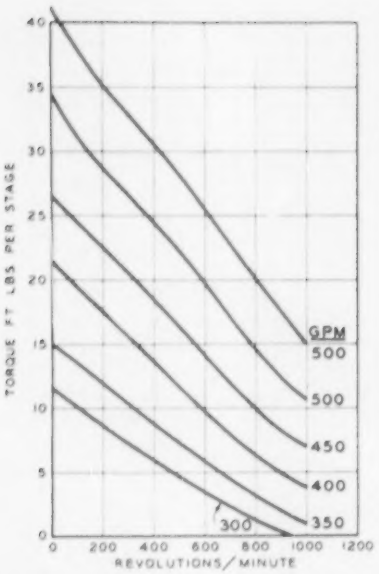
Trouble in early designs was due to short-circuiting of mud between the end joints of the stator castings and between the outer turbine housing and the castings. This bypassed mud eroded the castings as well as the soft steel shell. Consequently the long stator key of Fig. 2 has been replaced by circular disk keys on each separate casting. This permits the use of O-ring seals between shell and castings as shown in Fig. 3.

Drill shaft . . . As shown in Figs. 1 and 4, the drill shaft is a separate assembly from the turbine proper. One radial guide bearing is situated at the bottom end. One new modification of this bearing is the inclined ball races shown in Fig. 4. Here the balls move axially at the same time they rotate around the shaft. This reduces concentrated wear on the outer races.

In view of the marked success of the rubber guide bearings in use on the turbine rotor shaft a more durable rubber bearing should replace the present ball bearings. In addition to providing cushioning action, such a rubber sleeve bearing would be relatively unaffected by normal amounts of sand in the drilling mud. It would be lubricated by the mud as well.

Turbine characteristics . . . To guide the design and operation of the turbodrill, laboratory dynamometer tests have been made with 6, 7, and 9-in. turbines operated on water and two weights of drilling mud. Table 1 presents some of the general performance characteristics of the 7 and 9-in. turbines.

Torque and efficiency curves for the 9-in. turbine, operated by drilling



TORQUE-SPEED curves for 9-in. turbodrill operating on 14.3 lb. per gal. mud. Fig. 7.

mud weighing 89 lb. per cu. ft., are presented in Figs. 5 and 6. It will be observed that the mechanical efficiency of this size unit is a maximum at about 750 r.p.m. when passing 550 g.p.m. of mud. The pressure drop for the flow through this 9-in. turbine is shown in Fig. 7. Performance curves for other turbine sizes are of similar shape.

As may be seen in Table 1, the 9-in. 30-stage unit would develop about 90 hp. at 750 r.p.m. with 550 g.p.m. of 89-lb. per cu. ft. mud. At 850 g.p.m. this turbo would develop 190 hp. with a considerable increase in r.p.m.

Field tests . . . During the active 6-year development of the turbodrill before 1941, five oil wells totaling about 11,000 ft. were drilled. The drilling performance of the turbodrill on these wells is shown by curves B, C, D, E, and F in Fig. 8.

In most of this drilling, which was done in Greeley and in Midway Sunset field in southern California, the penetrating rate was roughly comparable to that obtained with the rotary at that time. One of the turbodrills completed all of the 3,000-ft. depth without any major maintenance. In a few instances the turbodrill's on-bottom drilling time was somewhat faster than the rotary for the depths involved but was slower at other depths (curve B).

After complete interruption of the turbodrill program during the war years of World War II, field testing was again resumed in 1950 using prewar turbodrill designs. One further well was drilled which totaled 3,000 ft. The drilling progress on this well is shown by curve A, Fig. 8.

Although the rate of drilling in this well is greater than that obtained in prewar rotary drilling, it is less than can now be achieved by present-day rotary drilling. However, this is an irrelevant observation since the object in virtually all this turbodrill development work has been to explore some of the various design features or operating phases of the turbodrills, rather than simply to secure maximum rate of penetration.

In the test in well 367-27-F, the mud flow through the turbine was tried at almost twice the rates that had been used previously. As had been anticipated with the prewar models, thrust-bearing breakage occurred due to heavy hydraulic thrust. But pertinent information was secured on bit performance at turbine speeds up to 1,200 r.p.m. Mud flow of 875 g.p.m. with a pressure drop of 1,100 psi. was used here, provided by two engine-driven mud pumps operating in parallel.

Speed indicator . . . Early field experience demonstrated the need for an effective speed indicator of the turbine. The speed of the turbine for a given mud flow depends upon the torque reaction from the bit and, without a speed indicator, is not directly controllable from the top. Consequently, a speed indicator is a vital accessory for coordinating bit loading, bit speed, and mud flow to obtain optimum results.

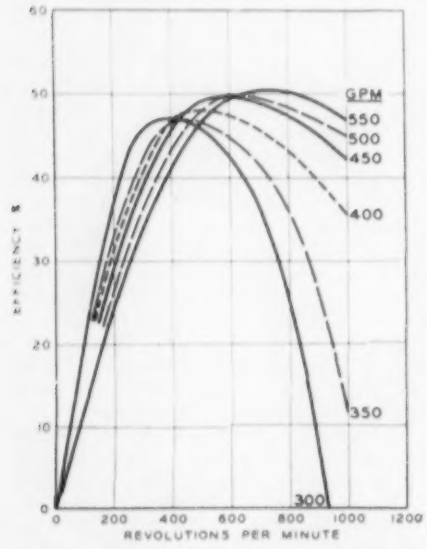
In the 1950 test, a speed indicator shown schematically in Fig. 9 was used. The unit is an alternating-current generator having a long alnico permanent-magnet rotor coupled directly to the top end of the turbine shaft. This rotates within a coaxial stator winding that is sealed in a welded stainless-steel case to exclude the mud.

The electrical output of the generator is transmitted to a long insulated electrode positioned immediately above the generator. This is a piece of 6-in. pipe coated with rubber on the outside. A stainless-steel jacket encases the rubber.

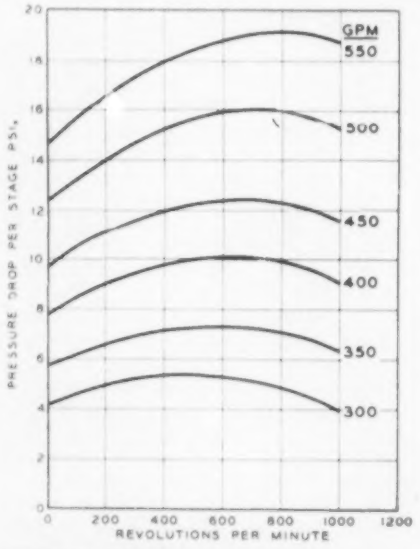
Rotation of the turbine-driven generator sets up an alternating current in the ground. Frequency of this current depends on the rate of rotation. Since the earth may here be considered as a semi-infinite conducting medium, the electrical current distribution extends outward in all directions from the electrode.

Although the current density decreases with distance from the source, a minute current flows along the surface of the earth in the vicinity of the well bore. This current is detected by two potential electrodes, one connected to the drill pipe and the other to the earth at some distance away. The potential between these two electrodes is but a fraction of a millivolt but is amplified by suitable surface instruments which also measure the frequency. A calibrated gage near the driller shows bit speed at the bottom of the hole.

Some additional work is needed with the electronic



OPTIMUM operating conditions for 9-in. turbodrill operating on 14.3 lb. per gal. mud. Best efficiency is presently 50 per cent. Fig. 8.



PRESSURE DROP required to drive a 9-in. turbodrill when 14.3 lb. per gal. mud is circulated. Fig. 9.

equipment used with the new speed indicator. The initial tests of this device were interrupted prematurely when the terminal of the generator was accidently broken on the trial run. Consequently, this device has not been proven below about 1,200 ft.

Remaining problems . . . In recent years well diameters on the whole have been reduced. The last hole drilled with the turbodrill was 12¼ in. which was necessary for the 9⅝-in turbine. Now this hole would normally be 10⅝ in. to take 7-in. casing. This would require turbine designs with diameters not over 8⅝ in. Smaller-diameter turbines down to 5½ in. have been designed and tested in the laboratory but field tests have not been made with these models.

Excessive side wear of the legs of the bits used with the high-speed turbine has been noticed. This evidently has been due to heavily overloading the mud stream at this point with the bit cuttings. The high speed of rotation (600 to 900 r.p.m. or higher) has not been accompanied by a sufficiently high circulating rate to remove cuttings properly.

A low-speed turbine (200 to 250 r.p.m.) with a high flow rate should give a more balanced design which would jet cuttings away from the bit.

The use of large-diameter lightweight drill pipe with full-bore tool joints offer obvious advantages and should be used with any turbodrill design. This would allow high flow rates with a minimum pressure drop.

Drill collars . . . All the turbodrilling to date has employed no significant amount of drill collars, and no drilling has been done with drill collars positioned below the turbine. There has been some evidence at times that drilling with the turbodrill results in a crooked hole. It has been contended that a heavy drill collar would help remedy this situation.

Positioning the drill collar below the turbine would provide very desirable flywheel and plumb-bob effects, and the net downward pressure on the thrust bearings should also thereby be stabilized. The violence of the bit reactions transmitted to the turbine should also be lessened with this arrangement.

In the course of turbodrill development the following patents were secured covering various design features:

Turbo thrust balance apparatus, April 8, 1952—2592519.

Turbo impact drill, October 14, 1952—2613917.

Automatic clutch, July 25, 1949—2167,019.

Radial ball bearing, June 16, 1942—2286528.

Safety collar, November 3, 1942—2301105.

Turbine runner and guide assembly, December 29, 1942—2306583.

Turbine-driven well-drilling unit, February 1, 1944—2340738.

Ball thrust bearing, May 2, 1944—2348046.

Mud turbine and method of assembling, May 2, 1944—2348047.

Oil-well drilling unit, July 11, 1944—2353534.

Balanced turbodrill, April 1, 1952—2591488.

Since the principal objective here is to stimulate interest in the further development of mud-powered turbines for drilling, the listing of the patents should not be construed as indicating desire to limit further development. They are presented to indicate the large amount of development and design work which is available to those interested in making the turbodrill available to the industry on a commercial basis.

2. Russians Boast "Success" for Their Turbodrills

This report, by a Russian drilling engineer, was published in the U.S.S.R. earlier this year by the Soviet Academy of Sciences, Moscow. Original title of the report was "Turbine Drilling in the U.S.S.R.," and the material was printed in both Russian and English. A copy of the article was obtained by the Journal editor in Rome during the sessions of the Fourth World Petroleum Congress, where a very limited number of the reports were distributed. Trebin claims that the U.S.S.R. turbodrill can drill up to 10 times as fast as rotaries.

by F. A. Trebin

ADVANCES in design during the last 15 years have encouraged wide field use of the turbodrill in the Soviet Union. About 65 per cent of all drilling is now done by this method.

Multistage turbodrills are used that will rotate at speeds from 500 to 900 r.p.m. and still deliver loads to the bit of 5,000 to 6,000 lb. per inch of bit diameter. Up to 450 hp. is developed at the bit. These work conditions cannot be obtained with rotary drilling, especially in hard formations and at great depths.

In hard formations, one type of turbodrill in use will drill up to 10 times as fast as a rotary string. This type of turbodrill is not very effective in soft formations, but one with different design has been used to double the rate obtained by rotary drilling in soft formations. The soft-rock turbodrill rotates slower than the hard-rock tool but develops more torque.

Different types developed . . . Tables 1 and 2 show the operating characteristics of a standard hard-rock turbodrill and a section turbodrill—a combination of two or three connected turbo-

TABLE 1—OPERATING CHARACTERISTICS OF A HARD-ROCK TURBODRILL (T12M2-10-IN.) WHEN DRILLING WITH WATER

Rate of circulation (g.p.m.)	Pressure drop (psi.)	Rate of rotation at maximum capacity (r.p.m.)	Twisting moment at maximum capacity (ft.-lb.)	Maximum capacity (hp.)	Efficiency (per cent)
870	780	670	2,090	272	69
950	925	730	2,500	353	69
1,030	1,090	790	2,930	450	69

TABLE 2—OPERATING CHARACTERISTICS OF A SECTION TURBODRILL (T53-10-IN.) WHEN DRILLING WITH WATER

Rate of circulation (g.p.m.)	Pressure drop (psi.)	Rate of rotation at maximum capacity (r.p.m.)	Twisting moment at maximum capacity (ft.-lb.)	Maximum capacity (hp.)	Efficiency (per cent)
665	853	515	2,280	228	69
713	985	550	2,650	282	69
760	1,120	590	3,000	341	69

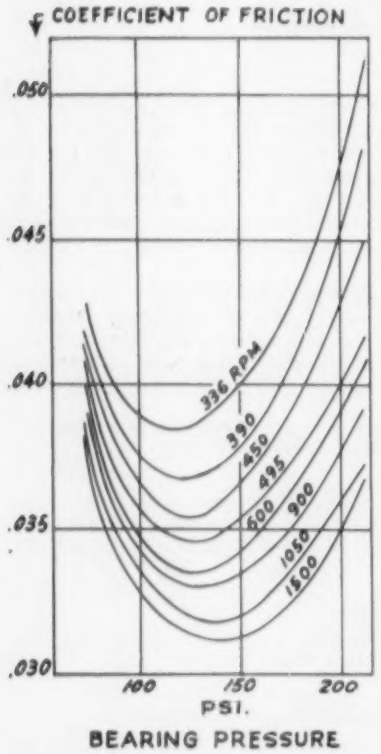
drills. The section drill is the more effective in deep wells due to the lower fluid rate required to produce the same power at the bit. In plastic-type formations, it also allows over one and a half times more bit footage than the usual turbodrill.

Turbodrills used currently have diameters of 6⅝, 8, and 10 in. Bits with diameters from 7⅞ to 19¾ in. have been used with these turbodrills. Recently a new design of a 5-in. 240-stage turbodrill has been made for extra-deep drilling. Boring is done with a 5⅝-in. bit. Efforts are also being made to develop a 4-in. turbodrill.

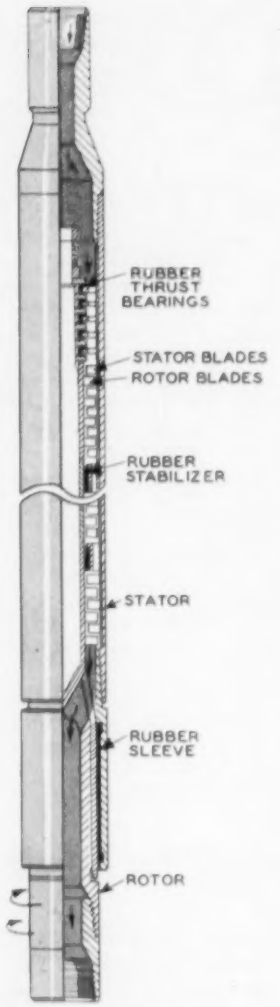
Design features . . . During the last decade the efficiency of the turbodrill turbine has been increased. The efficiency of the 1950 model turbines was about 55 per cent. The 1954 designs have efficiencies of about 70 per cent.

Improved profiles of vanes have cut down profile energy losses and losses in the vortical track beyond the vane's exit edge. A thicker and rounded entrance edge reduces the pressure rises during braking conditions which took place in former designs. It also increases the range of revolutions per minute that could be reached with maximum efficiency.

Decreasing the thickness of the exit edge has lessened losses in the vortical track. Broadening the axial clearance in the turbine between the stator and the rotor from 6 to 12 mm. has also increased the turbine's efficiency and improved its operating properties.



FRICTIONAL resistance of radial rubber thrust bearings. Driving and lubricating fluid is water. Fig. 1.



MULTISTAGE turbodrill used by the Russians. All guide and thrust bearings are covered by hardened rubber. Fig. 2.

Support bearings . . . Early use of steel bearings to take axial and radial loads was unsatisfactory. Abrasion by mud and sand caused rapid wear of the supports and operational failure. A lot of time was wasted because of forced raisings of the drill and idle runs.

A radical solution of the problem was found in sliding rubber bearings. These are used for axial support as well as for radial support of the turbine shaft. For the axial supports of the turbine rotor, which must bear loads of thousands of pounds, multiple-stage rubber bearings are used. The elasticity of the rubber allows all bearing stages to make contact and distributes the load so that specific pressures on the surfaces are limited to 200 to 300 psi.

The rubber bearings are lubricated and cooled by the mud or drilling fluid. Wear and tear of the rubber supports is much less than for steel supports. When abrasive matter (sand, mud particles, and particles of rock) penetrate to the friction surface, they easily press into the rubber surface without injuring it.

It has been established that in drilling with water the coefficient of friction in the rubber support of the turbodrill lies within the limits of 0.035 to 0.04. The coefficient increases up to 0.08 for clay-water slurries. An increase in density of the mud produces a further increase of the friction coefficient. Fig. 1 shows the dependence of the friction coefficient on the rate of rotation and the specific bearing pressure.

Fig. 2 shows the design of the 10-in. multistage turbodrill. Rubber support bearings for axial loads are at the top. Radial rubber support bearings for rotor alignment are spaced along the rotor. A rubber packoff sleeve and radial support is at the lower end of the rotor. The design of these supports allows inspection and exchange directly on the rig site. These improved rubber bearings serve for 150 hours or more.

Development of turbodrill use . . . Multistage turbodrills were first applied in Soviet industry in 1940. That year the volume of drilling by this method was only 3 per cent of the total drilling. In 1954 turbine drilling amounted to about 65 per cent of all drilling work.

Soviet scientists pay great attention to the transmission of high axial loads to the boring bit which determine the effective depth of face destruction on each pass. But at the same time, they consider high rates of revolution of the bit of no less importance.

Research work has developed favorable correlations between the amount of the axial load and the rate of rotation for different-type rock formations. This was done by using modern measuring methods and rapid film shooting to show how rock failure depends on contact time and striking force of the bit teeth.

Field use . . . With the improved design of the modern turbodrills, high rates of revolution with loads of 5,000 to 6,000 lb. per inch of bit diameter are possible. Since these turbines can develop up to 450 hp. at the bit, they are very effective in increasing drilling rates in hard formations.

In the Tuymazy oil area where rock formations are hard, rotary drilling speed of a well 6,000 ft. deep will

average about 6.5 ft. per hour. With the T12M2-10-in. turbodrill, such a well is drilled in 100 to 120 hours for a rate of about 50 to 60 ft. per hour.

It is also interesting to compare bit life for the rotary and turbine methods in drilling the Podolsk and Myachkovsky series. This is a very hard chert formation about 690 to 820 ft. thick. Rotary drilling methods wore out no less than 30 to 40 bits to drill this formation. Now, with turbine drilling, only 8 to 10 bits are used and the average drilling rate is about 80 ft. per hour.

Turbine drilling has also cut down the time for drilling wells in the eastern oil districts of the Soviet Union from about 175 days to 30 days. The over-all cost of drilling has been cut nearly threefold in comparison with the cost of rotary drilling.

Similar success has been obtained in hard-rock drilling in Rumania. The first experiments with the turbodrill increased the drilling rate fourfold.

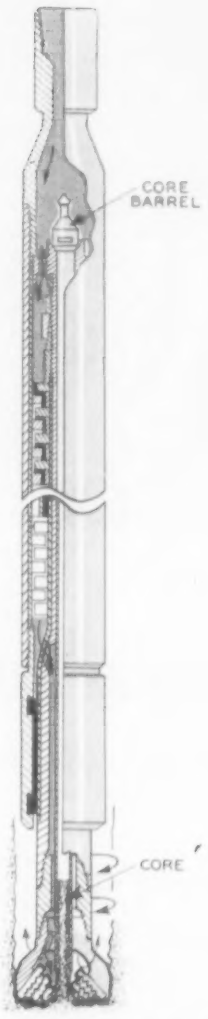
Improved indices for turbine drilling has been facilitated considerably by the wide-scale use of water as a drilling fluid in the eastern oil districts. Water is used as the drilling fluid in about 70 per cent of the drilling. The use of water increases the drill's efficiency because of reduction in friction losses in the support and better wear of the drill parts.

Less effective in soft rock . . . For a considerable time, the application of the turbodrill to drilling soft and medium-hard rock formations was ineffective. From 1949 to 1950, when turbine drilling was used extensively in the eastern districts, there was an insignificant amount of turbine drilling done in Baku, Grozny, and other districts of the Caucasus where rock formations are relatively soft.

However, research indicated that the poor performance of the turbodrill in soft rocks was due to insignificant face capacity and small twisting moment. Changes in turbodrill characteristics have improved the drill indices in soft rock.

In 1954 in the Buzovny oil district of Baku, several wells were drilled to about 6,500 ft. with the newly designed drill. Average drilling rate obtained was about 80 to 130 ft. per hour—twice the highest speed obtained by rotary drilling in this district. The first 3,000 ft. were drilled by one bit in 12 to 15 hours.

Deep-well drill . . . The Buzovny tests have shown that the turbodrill or modifications of it can be applied effectively in all types of rock formation. Especially effective is the use of section turbodrills (Table 2) in drilling at great depths. Here the necessity of cutting down the quantity of fluid pumped produces a reduction of the face capacity and a decreased moment of rotation of the turbodrill.



WIRELINE CORING type of turbodrill. Core barrel is held to outer stationary shell by special socket. Fig. 3.

Drilling with section turbodrills at depths exceeding 11,500 to 13,000 ft. nearly doubles bit footage compared with the ordinary turbodrill. The rate of drilling with the section turbodrills at such depths is about four to five times that of rotary drilling.

Directional drilling . . . Unlike rotary directional drilling in which a number of shafts are drilled outwards directed by whipstocks, the process of turbine directional drilling is continuous and is carried out with conventional turbodrills and bits. In this process, a constant force is brought to bear on the bit perpendicular to its axis.

This force is obtained with existing decliners. The type of decliner determines the magnitude of the force and the rate of change of direction of the bit. Two decliners are used: (1) decliners with a twisted piece of pipe or a twisted socket fixed directly on the turbodrill; and (2) decliners attached to the lower part of the turbodrill close to the bit. These are made in the form of slides attached to the body of the turbodrill.

The process of directional drilling with the turbodrill is so simple that it involves no more than 10 per cent more time than that required to drill vertically.

Coring . . . Early attempts to core with ordinary core devices used with the turbodrill resulted in poor recovery. Recently a special turbobore for coring has been designed to solve this problem. This is shown in Fig. 3.

This coring device differs from the ordinary turbodrill by having a through hole in rotor shaft. Above the upper stator it has a special fixed conical socket in which the core barrel is seated. The top of the barrel is pressed to the socket by hydraulic pressure so that it becomes immovable during coring. This insures a high core recovery.

The rate of coring with the column turbobit is practically the same as that of turbine drilling with ordinary bits.

Cutting round-trip time . . . As a result of widespread speedup of drilling with the turbine, there has been a sharp decrease in the time spent for mechanical drilling and an increase in the proportion of time spent on lowering and raising operations. New ways are being sought to cut the tripping time.

In 1954, successful tests were carried out in turbine-drilling two wells of the Saratov oil administration without raising the drill pipe. A special two-cone bit was used which will swing sideways to pass through an opening smaller than hole gage. The bit gage was 11⅝-in. and bit was lowered through 8-in. casing used as drill pipe.

Bit and turbodrill are lowered and pulled through the drill pipe by means of a special wire-line overshot. When in operation, the bit head becomes wedged in the body. The monolithic unity of the bit head with its body allows speedup conditions of drilling with high axial loads at the face and with high rates of rotation.

Rates of drilling by this method were slightly above the usual speeds of turbine drilling. The footage obtained per bit was 70 per cent of that achieved with ordinary three-cone bits.

Only half an hour was needed to change the bit in a hole 3,000 ft. deep. As a result, over-all drilling rates were increased substantially. Further work with this type of drilling is planned for 1955.

CLOSED VAPOR SYSTEM ties into a total of 20 tanks, 6 of which are blanked off from system, being in distillate-crude and other services. Vapor tank seen at right has a volume of 50,000 cu. ft.

Closed Vapor System Cuts Vapor Losses

by F. Lawrence Resen
District Editor

DELHI-TAYLOR OIL CORP. is using a closed vapor system on the gasoline rundown tanks at its Corpus Christi, Tex., refinery to curtail vapor losses.

The system utilizes a Horton vapor tank equipped with a flexible membrane, which is tied in with all of the storage tanks. As breathing occurs during temperature changes, or as tanks are being filled or emptied, the vapors either enter or leave the vapor tank. Internal volume of the 50,000-cu. ft. vapor tank, meanwhile, adjusts itself to prevailing conditions. The vapors cause the membrane to rise or fall, thus enlarging or contracting the available vapor space to meet prevailing conditions.

The vapor tank, a product of Chicago Bridge & Iron Co., permits the use of typical cone-shaped-roof storage tanks in rundown services without the loss of valuable intermediate products.

Tank layout . . . At Delhi-Taylor, a total of 20 tanks are tied into the vapor system piping (Fig. 1). Eight of the tanks have a 10,000-bbl. capacity and 12 have a 6,250-bbl. capacity each. However, six of the 6,250-bbl. tanks are presently blanked off from the system, being in distillate-crude and slop service. The remaining 14 tanks have a combined capacity of 117,500 bbl., and this is the total capacity currently being served by the vapor tank.

In sizing the vapor lines between the storage tanks and vapor tank, an allowance was made to provide a low pressure drop for obvious reasons. The allowable deemed practical was set at 0.70 in. of water. The calculated pressure drop on the installed system is 0.54 in. of water.

In keeping with these provisions, the minimum pipe size used on the vapor system was 6-in. Where vapors from two tanks had to be handled, the line was increased to 8-in. The vapor lines were increasted to 10-in. maximum for handling vapor from four or more tanks. In the layout, two 10-in. lines terminate at the vapor tank. One of these carries vapors to and from the eight 10,000-bbl. tanks and the other is tied in with the twelve 6,250-bbl. tanks.

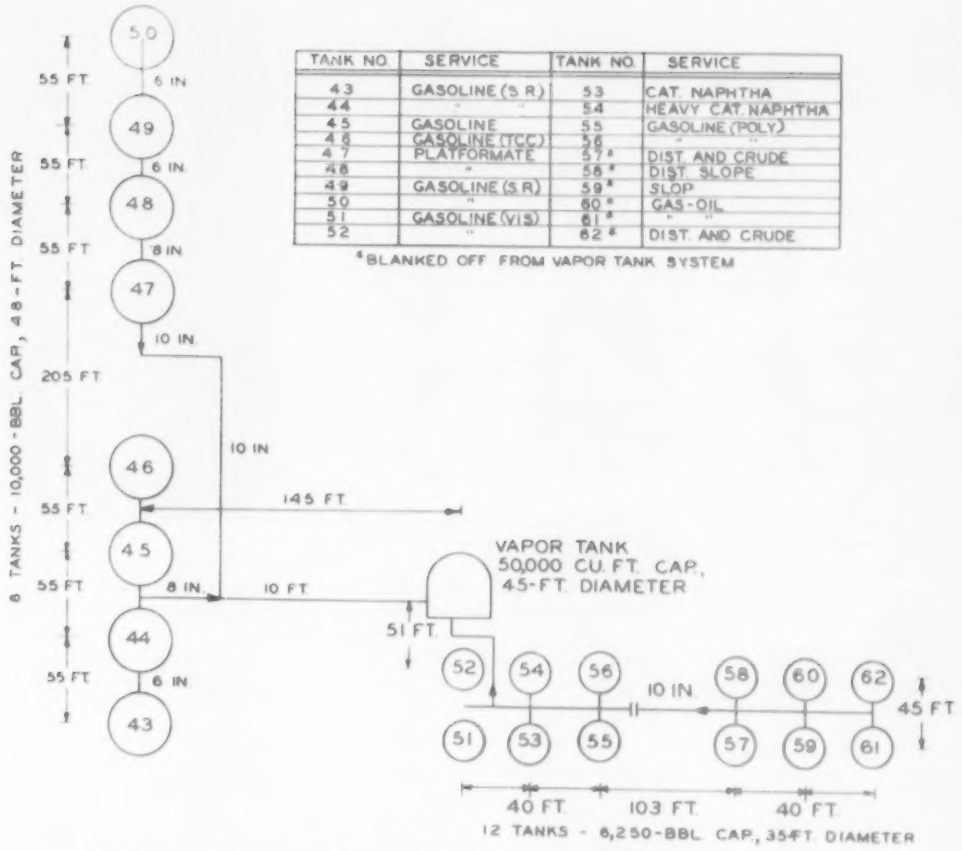
The 10-in. lines are laid out with a slight slope to prevent any liquid carryover from accumulating. In a 163-ft. run, this slope amounts to 9 in. This is sufficient to permit liquids to gravitate into the bottom of the vapor tank. Any such carryover is pumped out and rerun as necessary.

Vapor tank . . . The vapor tank shell consists of a cylindrical base 19½ ft. high, which is capped with a hemispherical dome having a 23-ft. radius, the same as the base. The flexible membrane is secured to an angle iron running around the interior of the tank, at about the level where the hemisphere and cylindrical sections are joined.

This diaphragm is made of a lightweight nylon cloth coated with a synthetic-rubber compound on both sides to a total thickness of 0.05 in. The combination provides a strong, durable membrane capable of resisting hydrocarbon liquid and vapor attack.

The diaphragm, in effect, floats on the vapors within the tank and is lifted by the vapor pressure. A pressure of only about 0.17 in. of water is sufficient to raise the membrane. A weight is secured at its center so that as the pressure decreases or increases, the membrane will roll away from the sides of the dome or up against it without rubbing.

A narrow-diameter steel line is attached to the steel plates which weight the center of the diaphragm. This runs over the side of the tank and is attached to a sliding member which travels vertically along the exterior of the tank. By using a graduated scale and the sliding member as an indicator, the position of the membrane can be determined at a glance.



TANK NO.	SERVICE	TANK NO.	SERVICE
43	GASOLINE (S.R.)	53	CAT. NAPHTHA
44	" "	54	HEAVY CAT. NAPHTHA
45	GASOLINE	55	GASOLINE (POLY.)
46	GASOLINE (TCC)	56	" "
47	PLATFORMATE	57 [4]	DIST. AND CRUDE
48	"	58 [4]	DIST. SLOPE
49	GASOLINE (S.R.)	59 [4]	SLOP
50	"	60 [4]	GAS-OIL
51	GASOLINE (VIS.)	61 [4]	" "
52	"	62 [4]	DIST. AND CRUDE

[4] BLANKED OFF FROM VAPOR TANK SYSTEM

DIAGRAM of tank layout at Delhi-Taylor Oil Corp.'s plant at Corpus Christi, Tex. Fig. 1.

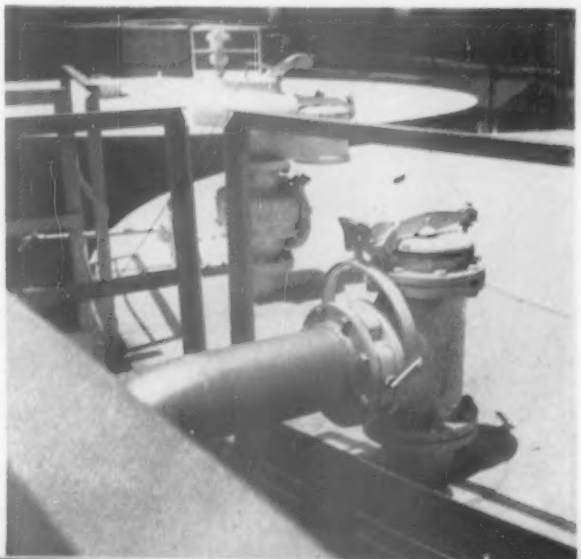
In its operation the action of the membrane will naturally depend upon the storage conditions. With most of the tanks nearly full, practically none of the capacity will be utilized, and the membrane will hang down in the tank. With the tanks all nearly empty, the entire capacity may be needed and the membrane will be lifted up against the dome. Should unusual conditions require additional capacity, a relief valve on the tank will vent to atmosphere so as to relieve the load on the vapor tank and associated system. Most of the time, the membrane will ride in an intermediate position; rising slightly or falling a small amount as it adjusts to temperatures affecting vapor system.

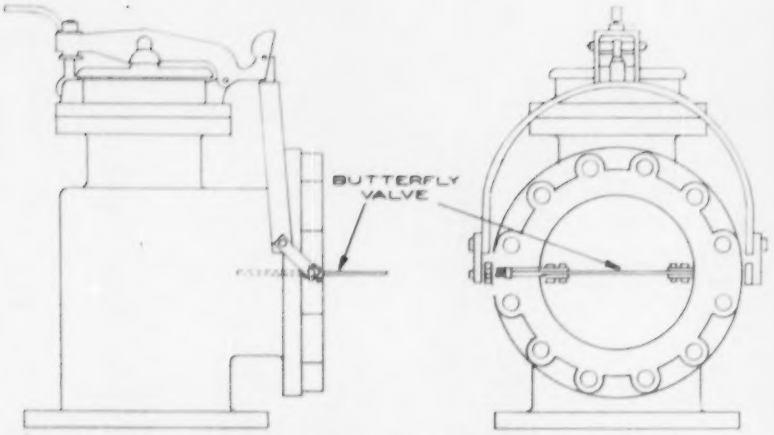
Storage tanks . . . In addition to the vapor-tank relief valve, all of the storage tanks are provided with individual relief vents. These are set up to operate on the pressure side at 1½ in. of water and on the vacuum side at 1 in. of water.

Because of the closed system, special fittings were necessary on the storage-

TO REDUCE PRESSURE DROP in system, lines are sized from a minimum of 6 in. to a maximum of 10 in.

SAMPLES can be taken without upsetting vapor system with combination gage hatch and vapor-line shutoff.



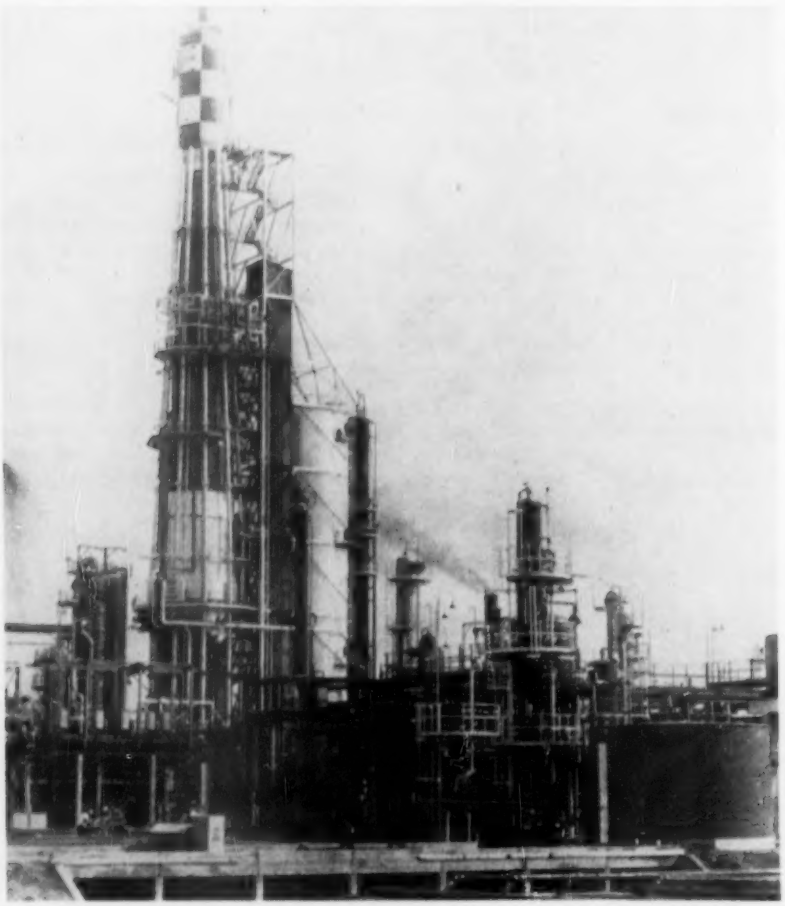


COMBINATION gage hatch and vapor-line shutoff blanks off vapor line when hatch is opened, isolating tank. Installation view is shown at right. Fig. 2.

tank bottom-reading gages. Gastight liquid-seal-type cable sheaves were installed on these units. As the wire line travels in and out of the tank, no vapor leaks occur as would be the case with conventional stuffing boxes.

Likewise, a special gage-hatch vapor-line shutoff fitting was installed at each sample hatch (Fig. 2). This Shand & Jurs fitting is equipped with a butterfly valve, which rides in the vapor-line outlet, and a clamping down device on the hatch. This latter element insures a gastight fit when the hatch is closed. Whenever the sample hatch is opened, a linkage device trips the butterfly valve in the vapor line, blanking it off.

Acknowledgments . . . Cooperation of the management of Delhi-Taylor Oil Corp. is hereby gratefully acknowledged, as is the assistance of J. J. Maurer, Jr., and J. H. Barnhart in the compilation of data.



Houdriflow Cracker Now On Stream at Petrofina's Montreal Refinery

A 16,600-bbl.-per-day Houdriflow catalytic cracking unit has gone into operation at the new refinery of Canadian Petrofina, Ltd., at Montreal, Canada.

The new refinery was designed for a nominal daily throughput of 20,000 bbl. of a wide variety of imported crude oils arriving by tanker and pipeline.

Charge to the Houdriflow cracker is at present light and heavy gas-oil from the refinery's vacuum distillation unit, and in the future will include gas-oil from a coking unit. Of the total charge to the Houdriflow, 10,000 bbl. per day will be fresh feed and the remaining 6,600 bbl. will be a recycle stream, heavier than diesel oil.

In addition to the vacuum distillation unit, the future coking unit, and the Houdriflow catalytic cracker, other major units in the new Petrofina refinery include catalytic reforming, catalytic polymerization, and alkylation.

Heavy fuel-oil production will be reduced to a very low value. Still lower production of heavy fuel is anticipated with the completion of the coking unit.

The Houdriflow unit was constructed by the Lummus Co. of Canada.

REFINING POINTER

Cosden uses wash-oil system to

Improve Vacuum-Unit Operation

Problem: Wire mesh screen in entrainment section of vacuum tower was plugging and channeling occured. Carbon content of gas-oil would increase and asphalt quality would be impaired, necessitating 4 to 6-month turnarounds.

Solution: Install wash-oil system to circulate gas-oil over wire mesh. Operating conditions improved, product quality upped, and tower run life extended to 12 months.

That's the story in a nutshell at Cosden Petroleum Corp.'s Big Spring, Tex., refinery, where simple modifications resulted in marked improvements.

In Cosden's operation, an average 9,000 bbl. of topped crude (20°-21° A.P.I.) is charged to the tower daily, with a reflux rate of about 9,750 bbl. The charge comes from a mixture of West Texas sour crudes (Howard-Glasscock, and Iatan-East Howard) containing about 1.5 weight per cent sulfur.

At first . . . The tower operated initially without a wire mesh entrainment section, which was installed after about 6 months' operation to reduce carbon content of the gas-oil used as charge stock for the fluid catalytic cracking unit. This early modification resulted in a considerable decrease in carbon content of the gas oil. Conradson carbon values dropped from an average of 0.60 per cent to 0.30 per cent and lower following installation of the mesh section (Fig. 1).

However, after the unit had been on stream a while, the mesh section would gradually become plugged and channeling would take place. The pressure drop through the mesh section would vary from a low of 0.3 in. of Hg to a high of approximately 1.5 in. of Hg due to carbon buildup in the mesh section. Cleanout of the unit would become necessary at this high value due to high carbon content of the gas oil and adverse effect on the ductility of the asphalt bottoms product. On-stream time averaged 4 to 6 months.

On inspection it was noted that plugging was more rapid in the lower section of the 4-in. wire mesh blanket. Replacement was made with two 2-in. blankets, and it was sometimes possible to achieve satisfactory results just by replacing the lower 2-in. section. The decision was made, nevertheless, to install a wash-oil system within the tower.

Gas-oil spray . . . The wash-oil system was set up to draw off about 40 g.p.m. from the reflux stream and spray this over the wire-mesh blanket (Fig. 2). A spray header was installed to distribute this wash-oil stream over the entire mat. Directly below the entrainment section is a new chimney tray including nine chimneys, and a drawoff leg on one side. Feed to the tower enters below this chimney tray and carries upward through the chimneys and on through the wire-mesh section. Meanwhile, the spray acts to knock the heavier materials down onto the tray from where dirty gas-oil is withdrawn by means of a liquid level control setup. A 1-in. line enters opposite the drawoff leg and circulates a small amount of dirty gas-oil to flush the chimney tray clean.

Under these operating conditions, it has been possible to increase the time between shutdowns to about 12 months or more. Additionally, Conradson carbon content of the gas-oil has been further decreased to 0.20 per cent.

Of further benefit has been the effect on downstream units. An increase in Conradson carbon of the gas oil increases the carbon laydown rate in the fluid unit to the point of upsetting balances around the unit. Efficient operation of the cat cracker demands control of the carbon content. Likewise, asphalt quality is easily maintained until plugging of the mesh section causes a pressure drop greater than 1 in. of Hg across the section. When this is kept clean, there is no difficulty, but when plugging, and hence the pressure drop, increases, meeting penetration and ductility requirements for the asphalt becomes more difficult.

Acknowledgments

Cooperation of the management of Cosden Petroleum Corp. in the release of this material is gratefully acknowledged as is the assistance of Allen R. Orr in compilation of data.

References

Orr, Allen R., "Case History—Cosden Petroleum Corp.," The Oil and Gas Journal, November 2, 1953.

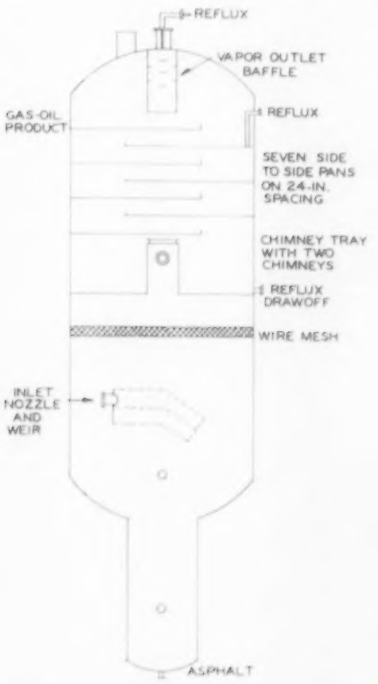


Fig. 1—Vacuum tower prior to modification.

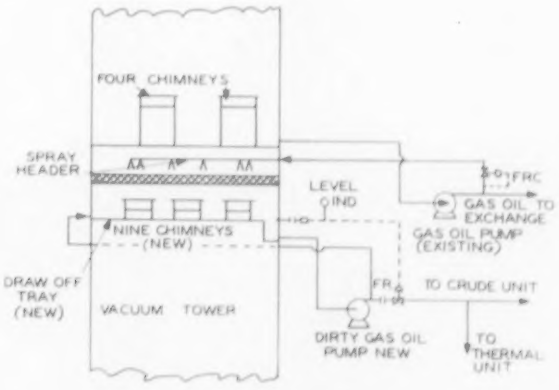
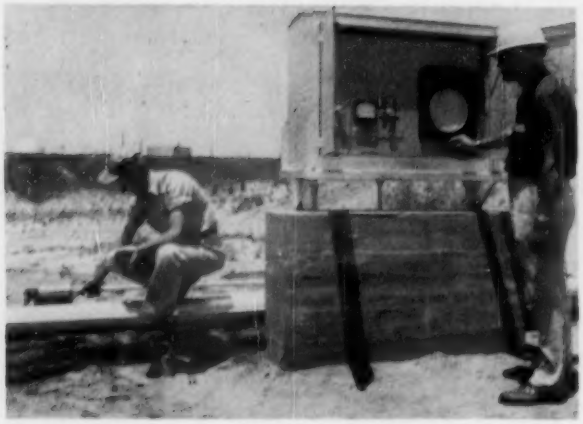


Fig. 2—Modifications to vacuum tower.



OPERATOR adjusts compensator at left, while Instrument Technician Paul Holden observes reading on micro-microammeter in panel box.

WITH LINE EMPTY, equivalent absorbers (small sheets of lead which absorb same amount of energy as material in line) are inserted between pipe and cell for calibration purposes.

REFINING POINTER

Audio Signal Announces Interface Arrival

Cosden Petroleum Corp. uses radiation device to measure specific gravity of incoming dual stream. Alarm system functions when interface reaches plant

by F. Lawrence Resen
District Editor

AN externally mounted radiation device is being used to measure the specific gravity of an incoming natural gasoline-isobutane stream at Cosden Petroleum Corp.'s Big Spring, Tex., refinery.

Coupled with an alarm system, the unit serves to announce the arrival of an interface. Thereupon the operator switches inlet tanks to receive the new stream.

The measuring device is simple in its operations. It merely clamps onto the pipe with no internal attachments or piping. It can be easily calibrated and requires no heavy power source—using 110-volt, 60-cycle current. Yet it accurately responds to a change in specific gravity and the interface is noted by a sharp break on the recording chart—as well as by an audio signal.

How it works . . . A special cell—the Ohmart cell—is utilized to receive and measure radiation. This cell is mounted on one side of the pipeline with a radioactive source mounted directly opposite on the other side of the pipeline (Fig. 1). The rays pass through the pipe and are picked up by the cell.

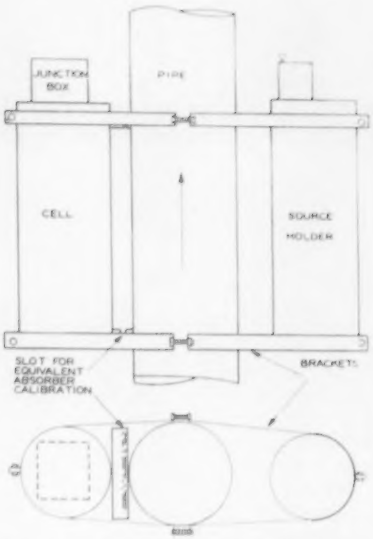
The denser the material flowing through the pipe, the weaker will be the ray penetrating through to the cell. Output of the cell, which is amplified and recorded, will then indicate a high specific gravity. Conversely, a light material in the pipeline will permit more of the rays to pass through and a lower specific gravity will be recorded.

Theory . . . In its functions, the nuclear radiation sensitive element of the instrument utilizes a phenomenon by means of which radioactive energy is converted directly to electrical energy. Its principal of operation is based upon a cell made up of two electronically dissimilar materials. If these materials are separated by a gas, and the cell connected to a current measuring device, a continuous current flows to the more active electrode.

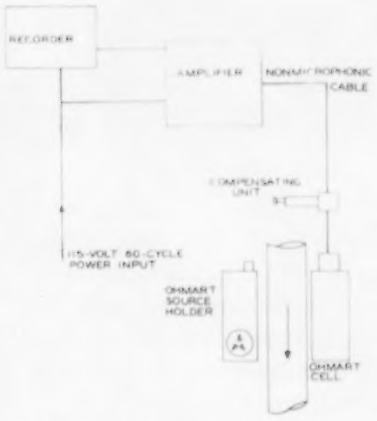
This flow occurs without an external source of voltage since the separating gas is forcibly ionized by exposure to nuclear radiation. By properly constructing cells, it has been possible to utilize this effort to measure alpha, beta, gamma, and neutron radiation; to analyze alloys; to measure the rate of growth of surface films and oxides; to measure vacuum and pressure; to measure humidity and to analyze gases.[1]

Density gage . . . In its application in this installation, the density gage, as it is called, is set up to measure the variations in specific gravity as the two different streams flow through the pipeline. Basic components include (Fig. 2):

1. The **radioactive source** mounted in the source holder. This provides radioactive energy for penetrating the pipeline and material contained therein.
2. The **Ohmart cell.** As noted, this receives the radioactive energy which penetrates the pipe and converts it into an electrical impulse.
3. **Brackets.** These position the sourceholder and cell on the pipe and also provide a slot for equivalent absorbers (see below).
4. A **compensating cell.** This is used to adjust the low output signal when calibrating unit.
5. A **coaxial cable** to carry the signal without interference to
6. The **amplifier.** This steps up the weak electrical impulse generated by the cell so that it can be measured.
7. A **micro-microammeter.** This provides a visual means of determining output of the cell, and is calibrated as noted below.
8. A **recording chart.** This is a 24-hour inked record of the specific gravity of material flowing through the pipeline. A takeoff from this system is tied in with a solenoid valve con-



LAYOUT of cell and source holder. Fig. 1.



FUNCTIONAL diagram, showing basic components of gage. Fig. 2.

trolling an air horn which sounds an alarm when an interface is reached.

In addition to the above, a set of equivalent absorbers is included as a means of calibration. These absorbers are strips of lead sheet and are as their name implies: they absorb the equivalent amount of radiation as that absorbed by material carried in the pipeline. When the line is empty and an equivalent absorber for, say gasoline, is inserted between the cell and the line, the specific gravity reading should be the same as for gasoline.

Calibration . . . There are three methods which may be used for calibrating the line, and all will be discussed, although Cosden generally uses the one simple method since they're primarily interested in the sharp change in gravities at the interface as opposed to a precise reading at any one time.

In **Method A,** the line is filled (within the area of the measuring cell) with a material of specific gravity equal to the lowest reading of gravity desired on the meter. For instance, in measuring through a range of 1.0 to 1.5, the reference for the low reading may be water. An adjustment on the compensating cell is made to bring the meter reading to zero. This sets the low point for the span of the instrument.

The line is emptied and filled with a material with slightly less specific gravity than the maximum reading desired on the meter. (For an instrument with a 1.0-1.5 reading, a 1.4 material is satisfactory). Since the meter reads from 0-10, a 1.4-specific gravity material should indicate 8.0 under the above-noted range. The amplifier control is adjusted to bring the high meter reading into line. The recording chart, incidentally, is calibrated to read directly in specific-gravity units. It is adjusted to read the actual specific gravity of material in line, whenever it is calibrated.

In **Method B,** the equivalent absorbers are used. The actual thickness of these is governed by both the specific gravity of the stream and the thickness of the pipe; which latter figure naturally governs the initial calibration in all methods, since the heavier the wall of the pipe, the more radioactive energy needed to penetrate same. Likewise, a smaller internal diameter means a smaller stream will be measured and this also will be adjusted for in the calibration.

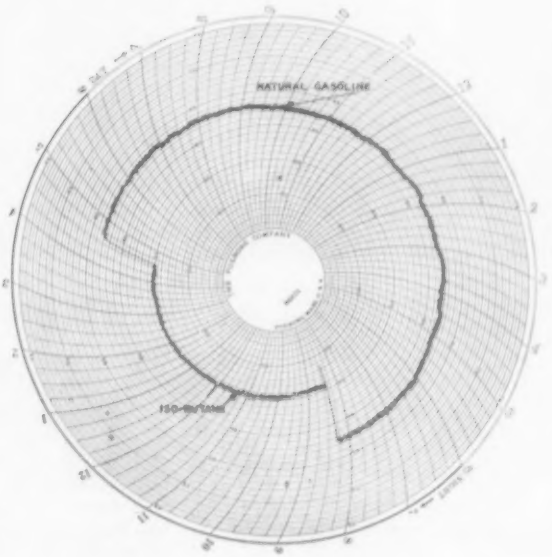
In this method, the line is emptied since an erroneous calibration will result if material is flowing or standing in the line. With the line empty, the lower-value absorber is inserted in the slot between the line and the cell. The adjustment is the same as for the low-value reading in Case A, and is made at the compensator. With the low value calibrated, the absorber is removed and the other inserted, and as before the high setting is made at the amplifier.

In **Method C,** generally followed by Cosden, the instrument is calibrated with the line full — and flowing — of either of the two streams being handled. In its operation, the flow comes into the plant against a back-pressure valve which insures that the pipeline segment where measurements are taken is always full. Hence, the instrument always records across the same cross-sectional area of material, and this is essentially the same as purposely filling the line for calibration purposes, as in Method A.

The specific gravity of either the gasoline or isobutane in the line is checked by the laboratory, and this figure used to calibrate the instrument, with low and high adjustments made as in the other two methods. In this method, the extreme limits of the gravity range are not set. The instrument is calibrated against the actual gravity of the material in the line. Thus, the recorder is set to read 0.545 when isobutane is in the line and 0.63 when natural gasoline is in the line (Fig. 3). Again, slight variations in properties of the streams are not significant, since the sharp break between the two streams is the controlling factor in operation of the unit.

Acknowledgments

Cooperation of the management of Cosden Petroleum Corp. in release of this material is gratefully acknowledged as is the assistance of Paul Holden in the compilation of data and information.



RECORD of specific gravity of isobutane and natural gasoline. Fig. 3.

References

1. P. I. Ohmart, "Investigation of a Method of Producing an Electric Current from Radioactivity," Atomic Energy Commission Report MLM-521.

Here's a quick review of today's thinking on

Gas-Lifting Both Zones of a Dual Completion

Rapid developments in gas-lift equipment — particularly wire-line-retrievable equipment — has brought new thinking about gas lifting in dual completions. This article deals with gas lifting both zones of dually completed wells. It gives the advantages, disadvantages, and design features of each kind of installation. It will enable you to pick the best type lift for your particular dual producer.

by H. W. Winkler

THE advantage of using a common gas source for lifting two zones is the low initial installation cost. However, flow-valve design is critical because one zone can starve the other for gas. A time-cycle surface controller on the flow line of the zone using most of the gas will help some. The surface controller can be set to shut in this zone several hours per day, thus allowing the starved zone to receive all injection gas during this period.

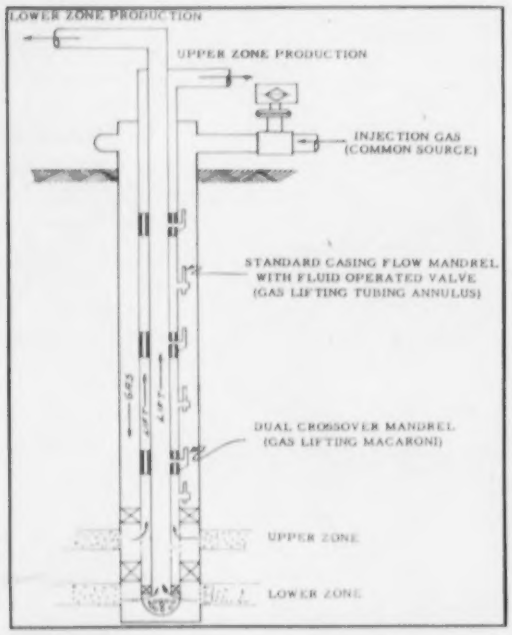
Concentric strings . . . Initial cost of the concentric-type installation generally is less than for the parallel string type; and it is readily adaptable to small casing sizes. If the casing annulus is used for injection gas for an intermittent-type installation (Fig. 1), injection gas-fluid ratios will probably be high. Because of the spread, (the difference between opening and closing pressure of conventional pressure-operated flow valves), the subic feet of gas passage per valve operation increases with pressure, casing size, and operating-valve depth. Moreover, design for intermittent operation with small tubing in large casing is extremely difficult. Capacity of small tubing is not enough to form the fluid slug necessary for a low gas-fluid ratio.

Large valve ports pass too much gas and prevent efficient operation. A small port or choked valve will remain open many minutes or, possibly, hours. The valve will not close before the necessary volume of gas passes through the small port opening to reduce the casing pressure to the closing pressure of the valve. These facts are extremely important in design of a small-tubing and macaroni installation to be run in large-size casing. Continuous flow design will generally perform better in this type installation.

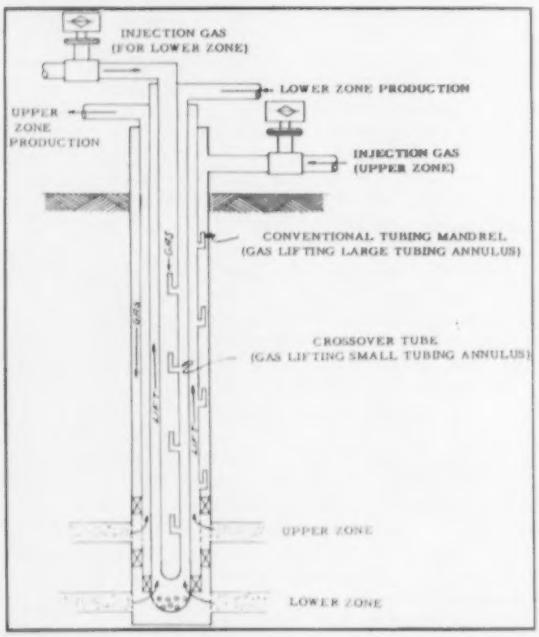
It's hard to get high rates of fluid production from a concentric type of installation even though the gas is injected down the annulus between the macaroni and tubing. This annulus area may be too small to pass enough gas. If the well is in a closed rotative system which requires gas storage, the small annular area is detrimental to the system.

For wells which can be casing flowed, the gas-lift installation can be designed to permit removal of both strings of flow valves without pulling the tubing. By running eccentric-type casing-flow retrievable-valve mandrels, the casing-flow valves can be selectively retrieved and replaced by wire-line methods, after the macaroni string has been pulled. This installation is ex-

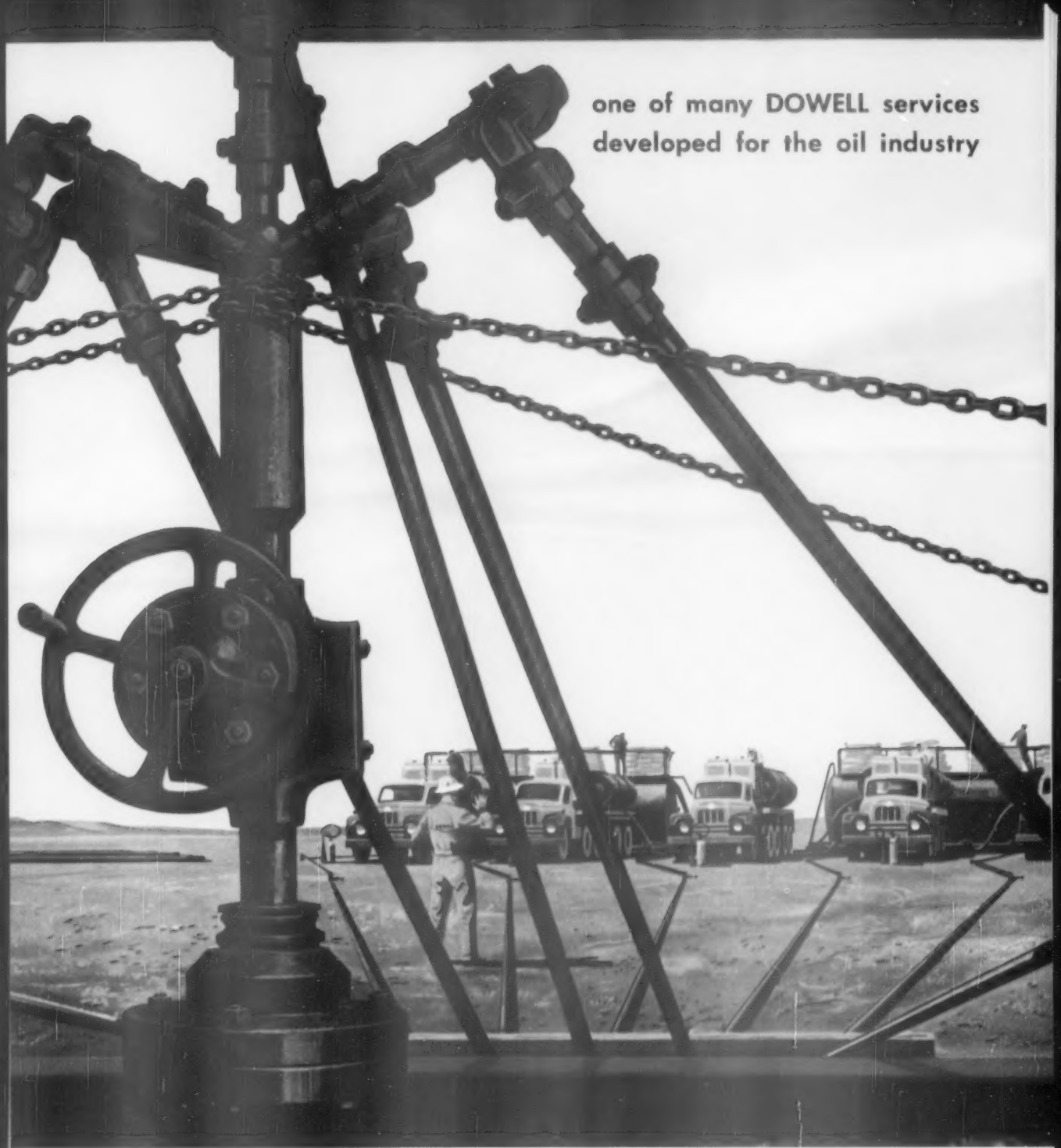
Author is with Camco, Inc., Houston.


LOWER ZONE PRODUCTION
UPPER ZONE PRODUCTION
INJECTION GAS (COMMON SOURCE)
STANDARD CASING FLOW MANDREL WITH FLUID OPERATED VALVE (GAS LIFTING TUBING ANNULUS)
DUAL CROSSOVER MANDREL (GAS LIFTING MACARONI)
UPPER ZONE
LOWER ZONE

CONCENTRIC-TYPE installation with common injection-gas source. Fig. 1.


INJECTION GAS (FOR LOWER ZONE)
LOWER ZONE PRODUCTION
UPPER ZONE PRODUCTION
INJECTION GAS (UPPER ZONE)
CONVENTIONAL TUBING MANDREL (GAS LIFTING LARGE TUBING ANNULUS)
CROSSOVER TUBE (GAS LIFTING SMALL TUBING ANNULUS)
UPPER ZONE
LOWER ZONE

COMPLETELY CONCENTRIC type installation with separate injection-gas sources. Fig. 2.



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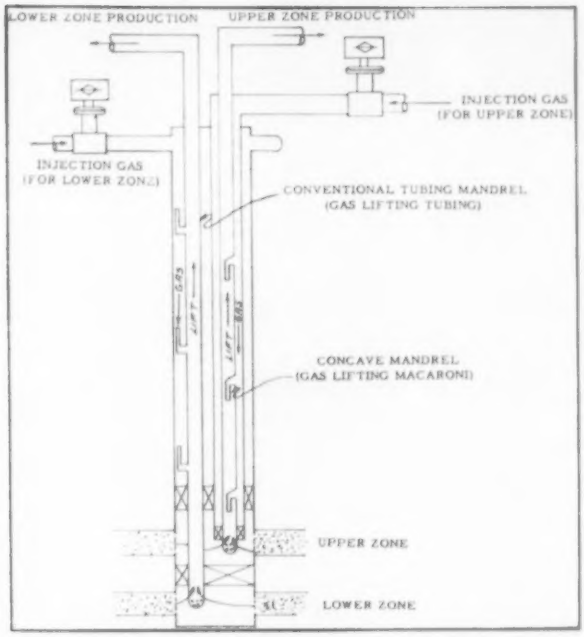
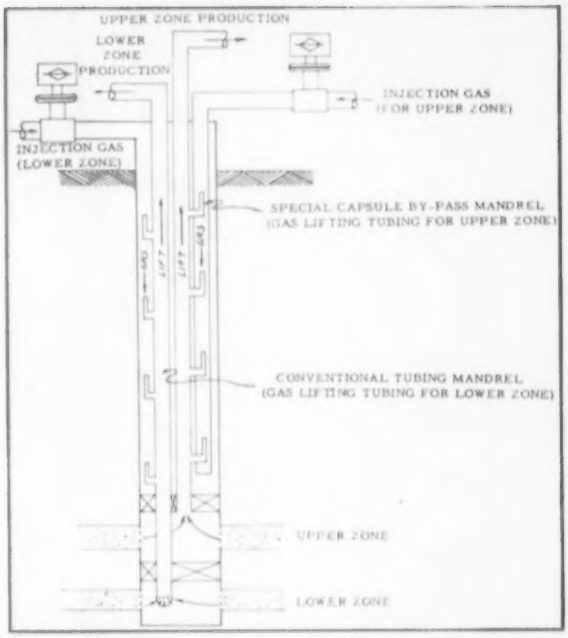


COMBINATION concentric and parallel type installation with separate injection-gas sources. Fig. 3.


UPPER ZONE PRODUCTION
LOWER ZONE PRODUCTION
INJECTION GAS (FOR UPPER ZONE)
INJECTION GAS (LOWER ZONE)
SPECIAL CAPSULE BY-PASS MANDREL (GAS LIFTING TUBING FOR UPPER ZONE)
CONVENTIONAL TUBING MANDREL (GAS LIFTING TUBING FOR LOWER ZONE)
UPPER ZONE
LOWER ZONE

COMPLETELY PARALLEL type installation with separate injection-gas sources. Fig. 4.

tremely flexible in comparison to other types using a common injection-gas source.

Parallel strings . . . Two full-opening 2-in. tubing strings with conventional pressure-operated flow valves can be run integrally or separately in 7-in. o.d. casing. If the strings are clamped together, standard mandrels can be employed. Special protective mandrels with deflecting-type lugs are necessary for running a detachable string separately. Moreover, the casing annulus will hold an adequate gas supply for lifting substantial rates of fluid from both zones. However, initial cost of parallel strings is higher than for concentric strings, and round-trip operation is sometimes hazardous.

By a minor modification of an additional string, parallel or concentric, the operator is assured of controlled injection gas for the lifting of both zones. Retrievable equipment is available which permits the gas lifting of two zones by a common gas source with all valves selectively retrievable. Also, combinations of 1¼-in. line pipe strapped to 2-in. tubing are available for 5½-in. o.d. casing.

Gas Lifting Two Zones With Separate Injection-Gas Sources

The three-string installation is the gas-lift engineer's choice for lifting two zones. The important advantage is that each zone has its separate injection-gas supply, eliminating the disadvantages of a common injection-gas source for lifting both zones. The flow-valve design is as simple as that for a conventional single-completion gas-lift well with the exception that two strings must be considered. Both strings can be the intermitting type without encountering the problem of one zone taking most of the gas. Each zone can be operated and tested completely independently of the other zone.

The three strings can be any of a number of combinations of tubing sizes and can be completely concentric, combination of concentric and parallel, or completely parallel. Concentric strings are more flexible in case of malfunction, because the macaroni or inside tubing can be pulled without removing the larger tubing. For this reason, the troublesome zone should be lifted by flow valves on an inside string.

If all the strings are parallel the complete installation must be pulled to replace one valve. However, parallel strings will produce higher rates than concentric strings.

The disadvantages of the three-string installation are: (1) it has a high initial cost, (2) it is complicated to run and pull, (3) it presents more of a problem in the event of a fishing job, and (4) it requires a large casing size for certain desired tubing combinations. In wells which will permit normal wire-line operations, the workover costs can be kept at a minimum by the use of completely wire-line-retrievable flow valves.

Three-string—concentric . . . A completely concentric three-string dual installation is out of the question in small casing. Only nonupset or flush-joint tubing will give enough equivalent areas for satisfactory operation. An example of this type installation would be a 1-in. macaroni inside 2½-in. nonupset tubing inside 4-in. nonupset tubing run in 7-in. o.d., 23-lb. casing, as in Fig. 2. Injection gas in the casing and inside or outside of the macaroni would be two of several variations of the concentric three-string installations. This type installation is seldom used because special packers and uncommon tubing sizes are required.

Three-string—combination . . . An operator can select one of four different designs for dually lifting two zones with a combination of parallel and concentric strings. Tubing sizes can be varied in each type to increase lifting efficiency and assure required production. Injection gas in the casing and tubing annulus or macaroni are the two types which will adapt to the majority of dual wells. Fig. 3 illustrates injection gas in the casing and tubing annulus.

By injecting gas in one tubing string, two additional combinations are possible. Using a concentric macaroni string permits flow-valve replacement at a low workover cost. Many combination parallel and concentric-type installations are now in operation in West Texas.

Three-string—parallel . . . A three-parallel string installation with nonretriev-

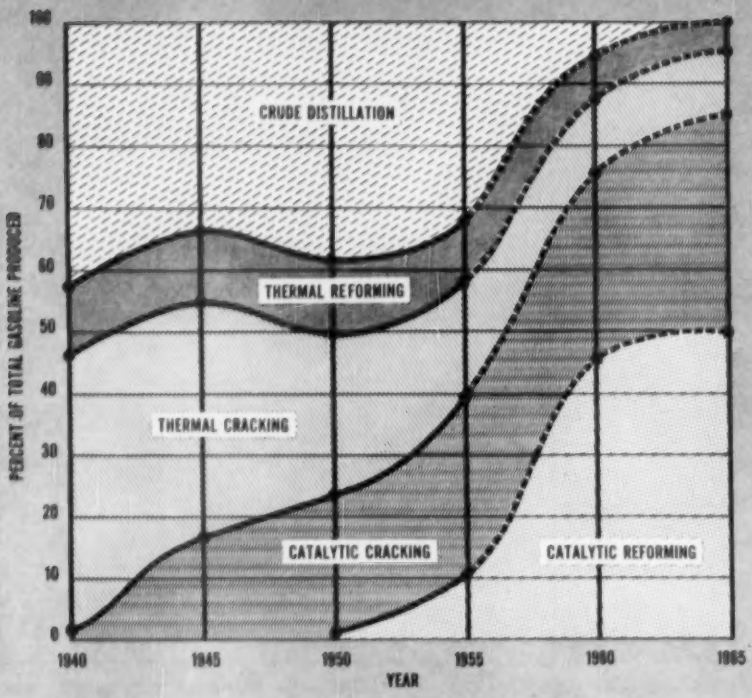


FIG. 1. Trends in processes for making gasoline. By 1965 catalytic reforming may account for 50% of all gasoline.

How to get your top octanes more economically

By HAROLD J. GIBSON
Ethyl Corporation, Detroit, Michigan

WITH the growing trend to better-grade gasolines, the cost of producing those last few octane numbers has steadily increased. As a result, refiners are looking anxiously for more economical ways to get their top octanes.

Already octane numbers in the 97 to 98 range are being marketed in the East and Southwest. And the trends for all U.S. refineries in terms of pool, regular and premium fuels show that octane numbers are continuing a slow, steady rise each year.

To meet the demand for higher-octane fuels, refiners are being constantly forced to change their processes. A look at the graph at the top of the page (Fig.1) will show you the gradual changes in process evolution. Note that by 1965 catalytic reforming may account for 50% of the total gasoline production in the industry.

Depending on the specific octane-improvement problem, the economic answer usually consists of a combination of tetraethyllead and various processing steps. (Some of these processing alternatives are displayed in Fig. 2.) The question becomes: How to determine the most economical way to get those top octanes. Only by conducting a detailed economic analysis can a refiner be sure of finding the best solution for his refinery, for from an economic analysis he can determine the proper balance between lead and a processing alternative.

An economic analysis will take into consideration all of the factors that affect the costs of making your gasoline: for example, optimum rates and yields, raw-material costs, product prices, operating manpower, maintenance and repair, utilities, depreciation, investment charges and reasonable "pay out."

TABLE 1. Estimated Pool Octanes and Premium — Regular Octane Numbers

		With 2.2 ml/gal TETRAETHYLLEAD	With 3.0 ml/gal TETRAETHYLLEAD
At the end of 1953	Pool	88.0	89.4
	Premium	92.9	94.3
	Regular	85.9	87.3
At the end of 1954	Pool	89.3	90.7
	Premium	94.2	95.6
	Regular	87.2	88.6
At the end of 1955	Pool	90.8	92.1
	Premium	95.7	97.0
	Regular	88.7	90.0

Octane improvement analyzed

From such an analysis you can determine the economics of octane improvement, which is the tool for obtaining the optimum sequence of processing steps and attendant use of tetraethyllead. Analyzing octane improvement costs calls for a thorough understanding of unit operating costs, particularly when incremental expenses are being considered.

There are several approaches for analyzing the costs of octane improvement at higher levels. At Ethyl we have found, through our studies of the economics of top octanes, that the key to cost analysis is a value called *incremental cost*. Simply expressed, this is the rate at which costs increase as you raise the octane number. It can be expressed conven-

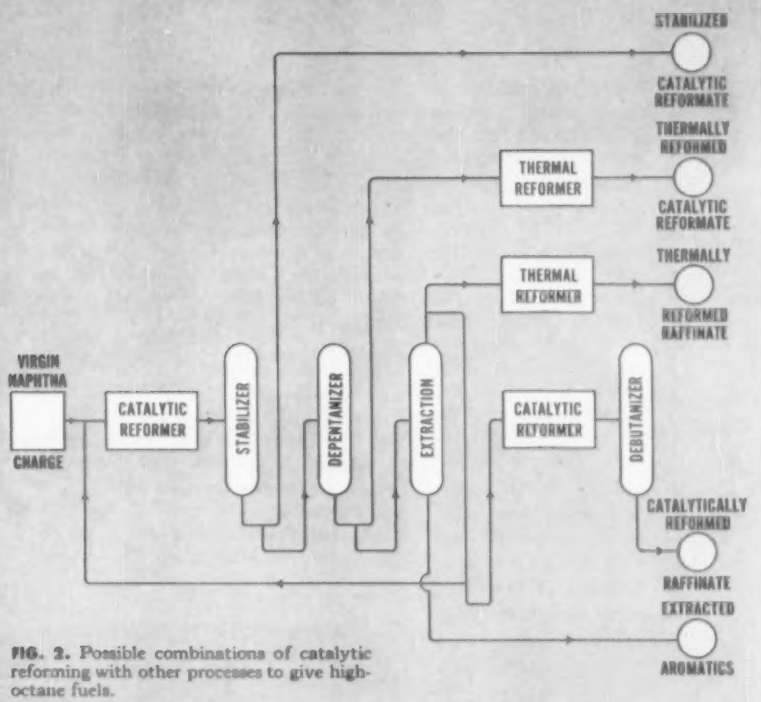


FIG. 2. Possible combinations of catalytic reforming with other processes to give high-octane fuels.

iently in cents per Research octane number per barrel. (¢/RONB).

Once you determine incremental costs, the next step is to make sure you are employing the best possible process at each point. By plotting the cost curves on a chart, you will see that up to a point the cheapest way to improve gasoline is with lead. Then lead becomes closely competitive with mild reforming methods.

After you reach an incremental cost of about 5¢/RONB, it again is definitely cheaper to add tetraethyllead. And finally when the full 3 cc of lead is used, you must return to reforming—this time at greater severity.

Today there's a greater trend toward using lead in higher concentrations for, as one industry spokesman put it, "tetraethyllead has decreased steadily in price while the costs of refinery construction have continued to rise rather sharply."

With constantly increasing gasoline-quality demands facing the refiner, it has become increasingly important to define the optimum route to high-octane fuels. Lead addition now costs an average of 4 to 5 cents per Research octane number per barrel, and this is directly competitive with the cost of mild reforming operations for octane improvement. As product octane levels increase, refiners may have the choice of using maximum tetraethyllead—3 ml/gal—or going to more expensive reforming operations—more severe single pass reforming or extraction followed by raffinate reforming. Here—even though lead susceptibility decreases somewhat in aromatic reformates—the cost of octane improvement by lead becomes increasingly more attractive as compared with various processing alternatives. Where extremely high octane levels are required, a refiner has little choice but to use the more economic tetraethyllead to the maximum and then to vary his processing alternatives to give the desired product quality if he wants to hold his manufacturing costs to a minimum.

KNOW THIS EQUATION?

$$¢/RONB = \frac{(Y-100-F)(Pg-9.4T) + Pb(F+G) + Pf100H - 100E}{100\,RONp - 100\,RONn - 10F + Y(RONr - RONp)}$$

You should if you are making an economic analysis. Write for a copy of a recent 50-page report giving a definition of terms of this equation and other information on new processing alternatives and on the economics of top octanes. Address your request to Department No. 11 Ethyl Corporation, 100 Park Avenue, New York, New York. No charge.

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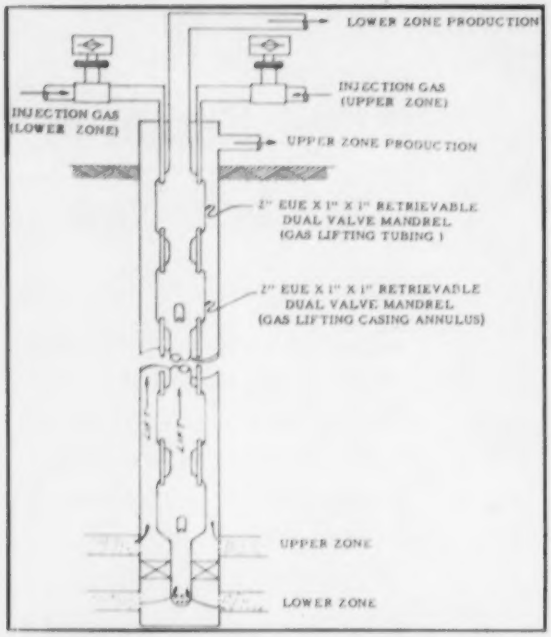
LOWER ZONE PRODUCTION
INJECTION GAS (UPPER ZONE)
INJECTION GAS (LOWER ZONE)
UPPER ZONE PRODUCTION
2" EUE X 1" X 1" RETRIEVABLE DUAL VALVE MANDREL (GAS LIFTING TUBING)
2" EUE X 1" X 1" RETRIEVABLE DUAL VALVE MANDREL (GAS LIFTING CASING ANNULUS)
UPPER ZONE
LOWER ZONE

THREE PARALLEL strings employing retrievable mandrels with separate injection-gas sources. Fig. 5.

able-type flow valves can be designed to meet the producing characteristics of the zone to be lifted. Some examples are:

1. Injecting gas in the casing and small tubing to lift the two tubing strings. An example of this type of installation, Fig. 4, would be two 2-in. tubing strings and a smaller tubing string attached to special capsule by-pass mandrels. The smaller string supplies gas for the valves inside the special mandrels for gas lifting one string of 2-in. tubing. Conventional or concave mandrels with flow valves would be run on the other string of tubing, and the injection gas supplied from the casing annulus.

2. Injecting gas in one tubing string and a smaller tubing string to lift through the casing annulus and the other tubing. The installation is the same as the previous type with the exception of casing-flow mandrels being substituted for the conventional or concave mandrels on one string of tubing. This installation is desirable when very high producing rates are required from one zone.

3. Gas lift with three-string retrievable equipment. The most recent development in wire-line-retrievable flow valves for three-string duals incorporates one 2-in. tubing string with two 1-in. line-pipe strings strapped to the tubing. Retrievable-valve mandrels can be obtained which permit gas lifting through one of the 1-in. strings with injection gas from the other 1-in. string. The tubing is lifted by injection gas from the casing. If both zones have a high productivity, the mandrels can be constructed to gas lift the tubing and casing by individual gas supplies from a separate 1-in. string for each zone. See Fig. 5. All flow valves are selectively retrievable from the full open 2-in. tubing string, and the mandrels are designed to be run in 5½-in. o.d., 17-lb. casing.

Small tubing sizes and small annular areas between the macaroni and conventional tubing string result in high flow gradients. According to Fanning's equation, the capacity of two different sizes of tubing for single-phase fluid flow is a function of the ratio of the tubing diameters to the 2.5 power. A rate of 250 bbl. per day through 1¼-in. tubing would be equivalent to approximately 1,000 bbl. per day through 2-in. tubing.

The multiphase vertical flow of an actual gas-lift well is a more complex problem. An extrapolation of pressure traverses for 1¼-in. tubing, employing the method of Poettmann and Carpenter, revealed the flowing gradients in 1¼-in. tubing to be extremely high. Resulting gradients indicate that a high injection pressure is necessary for nominal depths. Suppose an operator wanted 250 bbl. of fluid per day from a low fluid-level well. Through 1¼-in. tubing, from a gas injection depth of 5,000 ft., he would need a surface injection pressure in excess of 1,000 psi. The flowing gradient in small tubing, as compared to that in 2 or 2½-in. tubing, becomes excessive for relatively low continuous producing rates and a reasonable surface injection pressure.

Annular flow results in considerable turbulence from the small tubing couplings and mandrels; therefore, the efficiency of an intermitting installation through small annular area is doubtful. By the use of large tubing and small macaroni strings, high rates of fluid production are possible by continuous flow through the tubing annulus from high-productivity, high-bottom-hole-pressure wells.

Setting depths . . . To run the desired size macaroni in a tubing string already in the well will often require a nonupset tubing. Small nonupset tubing strings are limited in the depth to which they can be run because of the weakness in the threaded section of the coupling. Should a packer be necessary on the macaroni string for efficient gas-lift operation, a high safety factor in tension must be included for pulling this packer. This further reduces the already short setting depth of a nonupset string.

Deposition problems . . . Paraffin or scale deposition must be considered. Experience shows that annular flow is bad for fluids which deposit paraffin, carbonates, or sulfates. The pulling of the macaroni can become difficult, if not impossible, as a result of this condition. Deposition can generally be reduced or eliminated by the proper chemical injected into the lift gas.

Flow-valve selection . . . The decrease in the opening pressures of pressure-operated valves with depth should be as great as possible. The high resistance to flow in a small annular area or macaroni string may cause the upper valves to open before the pressure can be transmitted to the desired operating valve. If the available kickoff injection pressure is low, a significant decrease in valve-setting pressures is impossible. Then, a choke installed downstream of the surface intermitter is desirable to prevent opening of the upper valves.

Selection of the proper flow-valve port or choke size is most important for gas lifting through a small macaroni or annular area. It can be extremely critical if the injected-gas supply is in a large casing annulus. Fluid-operated or intermitting valves should generally be choked to prevent excessive gas passage. The increase in flowing gradient from excessive injection gas imposes a back pressure in the small eductor tube, and higher back pressure will reduce the fluid production.

Differential valves with orifice equivalents varying from 3/64 in. to a maximum of 6/64 in. have been used with 1¼ and 1½-in. tubing sizes for 3,000-ft. wells. Fluid-operated valves with choke sizes from 4/64 to 8/64-in. have been run on 1¼-in. tubing strings to depths in excess of 6,500 ft. Gas passage has been ample with these orifice or choke sizes. When a small annular area or macaroni string supplies the injection gas to the valves, ¼-in. ported valves have been satisfactory.

In this case the rate of flow is restricted by the passage of the gas down the hole as well as through the orifice. Where injection gas pressures are low the larger choke sizes should be used.

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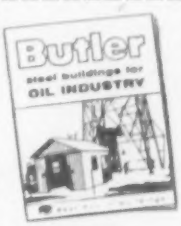

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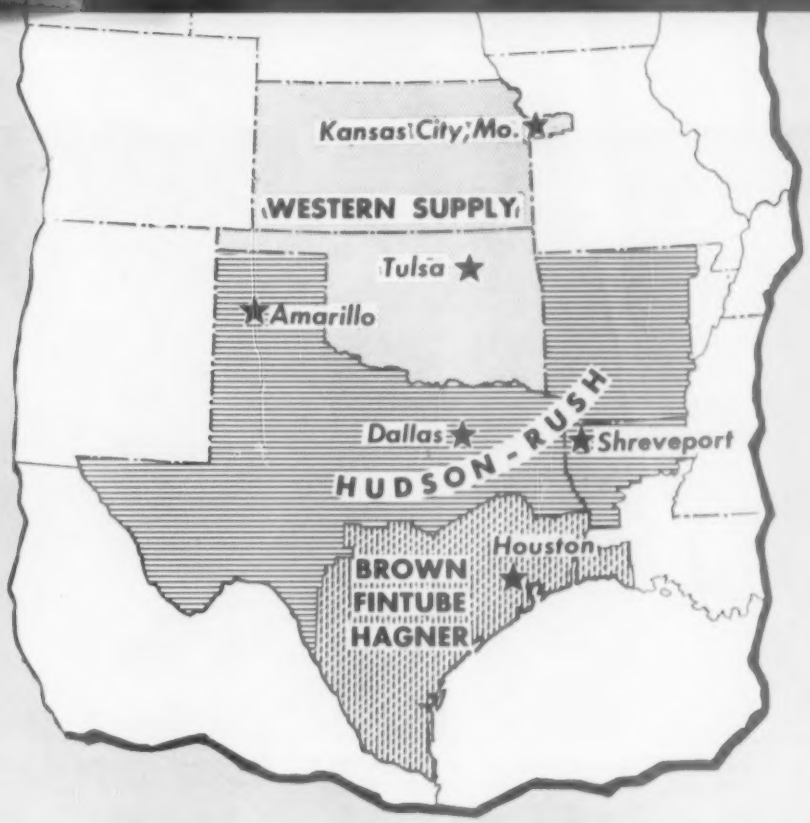
E. D. ANDERSON
Chief Engineer, Western Supply Co.

ROBERT C. HAGNER
District Manager, Brown Fintube Co.

We proudly announce that the Heat Exchanger Division of Western Supply Company, under the extremely able direction of "Jim" Hughes, Vice-President, is now exclusive Sales Representative of our products in Oklahoma and Kansas, also Kansas City, Missouri, where a local telephone will be direct connected to the Tulsa Office. This appointment assures prompt and experienced assistance to our present and future customers in this important territory;— and also enables us to welcome back into the Brown Fintube family, "Ed" Anderson, who formerly was a member of our home office research and rating staff.

Robert C. "Bud" Hagner, who formerly handled our products as a manufacturers representative is now Manager of our direct factory branch office newly opened in Houston. Thus, he will now devote his entire efforts serving the heat transfer requirements of our customers and prospects in the Houston area.



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HOW NOT TO DO IT. This line exploded as crude was being displaced with water followed by air. Note regular interval of ruptures.

AIR-WATER SEPARATION PLUG as it was found after explosion. Blasts probably started at plug, damaged 2½ miles of pipeline.

How to Empty a Pipeline

It's a risky job, and the industry hasn't all the answers yet

When a crude line must be taken from service, removal of the line fill presents a tougher problem than is first imagined. Will water, air, or gas be used for displacement? If water is used, how will the oil-water mixture be disposed of? However it's done, how can maximum safety be achieved? These and many other questions must be answered. This article gives current practices in the pipeline industry with good and bad points of each method.

by S. C. Phelps

IN the relatively short history of the pipeline industry, several thousand miles of pipe of all sizes from 2 through 16-in. have been displaced of their load of crude oil or refined products.

These have been displaced for one of three basic reasons:

1. To permit extensive external repair where severe corrosion or other physical weakness dictate that, for safety or other reasons, repair of the line should not be attempted with the line loaded.

2. To permit internal cleaning either prior to switching to other service (usually from crude oil to refined products) or prior to internal coating against internal corrosion attacks.

3. To permit salvage of the pipe for reuse or sale where a pipeline has reached its physical or economical service life.

Author is chief engineer for Interstate Oil Pipe Line Co., Shreveport. Paper was presented at the American Society of Mechanical Engineers' petroleum mechanical-engineering conference, New Orleans.

Methods and Objectives

Basic methods of displacing hydrocarbons are limited in number. But many variations of each are employed by various pipeline companies depending on diameter, length, terrain, and numerous other factors. The mediums or substances used to displace hydrocarbons in the probable order of their magnitude are: (1) water; (2) air; (3) natural gas; (4) Varsol or similar wash solutions; and (5) water washes with detergents or alkaline degreasing compounds.

Before probing deeper into the mechanics of the methods and some of their advantages and disadvantages, the basic objectives of displacing the line load should be explained. The main ones are:

1. To recover the line load for its economic value.

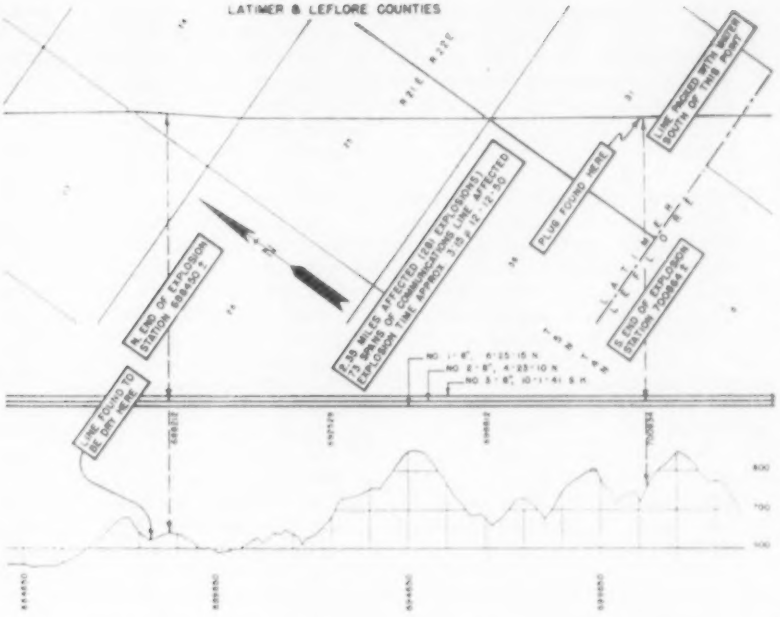
2. To prevent crop damage, water pollution, or other damage.

3. To prevent a potential fire and/or explosion hazard.

4. To prevent damage to the pipe itself.

5. Prepare pipe for repair or salvage.

The line load or displacement, whether crude oil or a refined product, is a commodity which usually must be recovered. In short, small-diameter field lines, it is sometimes ad-


LATIMER & LEFLORE COUNTIES
R. 22 E.
R. 23 E.
T. 7 N.
T. 6 N.
LINE FOUND TO BE DRY HERE
N. END OF EXPLOSION STRING 68 RADIO P.
2.30 MILES AFFECTED (SIX EXPLOSIONS) 1.2 SPANS OF COMMUNICATIONS LINE AFFECTED EXPLOSION LINE APPROX. 3.0 P.P.
PLUG FOUND HERE
LINE PACKED WITH WATER SOUTH OF THIS POINT
S. END OF EXPLOSION STRING 70 RADIO P.
NO 1 - 8", 6-25-15 K
NO 2 - 8", 4-23-10 K
NO 3 - 8", 10-11-41 S K
400
300
200

DETAILED PROFILE of that portion of crude line damaged by explosions.

visable to gravity-drain or remove the line load by taking suction with a reciprocating pump. These usually leave some oil in the line which is eventually lost. When attempting to recover the line load, its economic value must be protected by eliminating as much contamination as possible. Thus, one of the major concerns in the mechanics of displacement is to prevent contamination, especially if water is used.

When pipelines are to be parted for repair or modification, or are to be cut for take-up following displacement, any oil or oil-water mixture which escapes may result in immediate damage to crops, orchards, or livestock. Stream, pond, or lake pollution is always a matter of concern because of possible harm to fish and water fowl. Oil into water sources in irrigated areas may cause resulting crop damage many miles away.

Oil loss and fires . . . Along with concern for damage from oil contact is an equal concern for fire or explosions that are an ever-present possibility whenever oil escapes from a pipeline. Pipeline personnel are trained to take care of such loose oil and their proficiency is demonstrated by the industry's safety and fire-loss history.

Regardless of how much the dangers may be minimized, they cannot, from their nature, be totally eliminated. Through urban areas, through forest, grain lands, or prime pasture lands, extreme precautions are taken. Whenever lives of the public or company employes are at stake or where property may be damaged, no pipeline company permits preventable loss of oil from its lines. Thus, for these first three objectives, it is desirable that as near 100 per cent of line load as possible be displaced into tankage or other pipelines.

Freezing danger . . . The fourth objective of preventing damage to the pipe itself usually consists of two phases. First is usually the possible damage from freezing if water is used to displace the line. Timing operations to displace the line with water during the safe part of the year is the first simple solution. But this may not always be possible.

If the line has passed its physical or economic service life and is to be salvaged, other factors may dictate that it remain in place. Some of these are: Lack of a market for used pipe or in general for pipe of a particular size and grade, high takeup cost because of late-harvest crops, ad valorem tax, and lack of an immediate use of the particular pipe, are some of these factors.

Even if the company plans to reuse the pipe at a later date as part of its material supply, it may hesitate to spend money to takeup, haul, straighten, clean, bevel, and otherwise recondition the pipe for reuse. Lack of storage space near the takeup point, uncertainty of the geographic area where it will be used, possibility of misguessing as to the storage point, and possible reshipment as well as tying up of capital may dictate leaving the pipe in the ground for some time.

In general, most lines displaced with water (except those located in an area where freezing temperatures are not expected at pipeline depths) will often require displacement of the water to prevent a major risk of freezing and bursting.

Second is the possibility of inducing faster internal corrosion. Even the best of the water available for displacing pipelines will cause this. Contaminants present in the water will usually only increase corrosion. This will not only decrease the wall thickness and reduce its strength, but will also increase the inside-wall roughness and decrease the flow capacity through the line if reused as line pipe.

Whatever the ultimate reuse of the pipe—as well casing, as structural members, or any of the many other uses for second-hand pipe—this corrosion is an economic loss. If the line is to be left full of water, the use of an inhibitor in the displacement water might be considered advisable. The length of time the pipe is estimated to remain in the ground, its economic value, and estimated possible damage from corrosion are factors.

Salvage and safety . . . The fifth objective of preparing the pipe for repair or salvage usually relates to safety for repair or takeup crews and possible damage to the pipeline. If the pipe is in poor condition from internal or external corrosion, weak threads and couplings, weak welds, etc., it may not be advisable to repair it in service. In this case most safety regulations would normally prevent hot work on the line unless it is entirely gas-free.

In general, this type of repair work is fast disappearing in most pipeline companies. Main lines operating near capacity cannot be taken out of service long enough for such work. Except for short, hot-spot reconditioning on stub or secondary lines and occasionally gathering lines, we do not find such major repair work being employed. The indicated extreme deteriorated condition of the pipe, the economics of a better external coating, and over-all cheaper cost (usually considerably less labor) of using replacement pipe have decreased the frequency of such major repair programs.

No cases are known in recent years of a major repair program extensive enough to economically justify displacing and gas-freeing a pipeline. Hence, this phase usually consists of spotting a slug of water only in the section to be repaired, cut, modified, relocated or handled. This water will then minimize hazards of cutting, welding, and handling.

Where the line is to be taken up

and salvaged, some precautions for takeup must be considered in determining the means of displacement. If water is used and the line is to be taken up almost immediately, interference of the water load is of some concern. But it is usually minor, particularly if the line is freed of all but a trace of oil.

If air or gas is used, the possibility and probability of a fire or explosion hazard must be determined. And the procedure for detecting and removing the hazard and for cutting and takeup must be devised.

Displacing Practices—Their Advantages and Disadvantages

Water displacement is perhaps the simplest and easiest method used by pipeline companies. If an ample supply of water is available or can be accumulated, full displacement with water is usually made. If water is scarce, a slug only may be used.

Full displacement has the advantage of using any displacement rate desired and any pressure required to overcome static and friction heads encountered limited only by pump capacity and head.

If enough pump capacity isn't available in a regular pump station, most companies have portable equipment that can be set for temporary use at any point desired.

A batching-type plug consisting of a series of rubber cups on a mandrel, is run between the oil and water. Multiple plugs have been run together, but no benefits can be attributed to this according to our experience. Present-day commercial plugs with three or four rubber cups are effective separators of oil and water under most conditions. They minimize contamination of the oil being displaced.

Displacement rate is usually very close to the usual pumping rate through the line, especially where an existing pump station can be used to pump the water. However, if portable equipment must be used or for other reasons a slower rate is used, it is desirable to keep flow rates in the turbulent range if possible. Most displacement rates are from 2-5 ft. per second.

Where multiple lines or loops along a line are to be displaced, contamination must be watched closely. No procedure can be given because each case must be analyzed individually. Normally, but not always, it is better to displace each parallel line or loop separately. If displaced simultaneously, some variation in length or flow rate will cause different arrival times at the end of the loop or parallel line.

It is often impractical to establish the required sampling procedure at such points, and often impossible to shut off or pinch the flow in one line should the water reach the point in it ahead of the other line. Leaking valves in crossovers or other manifolding at such points may cause unexpected contamination, particularly if parallel lines or loops are displaced separately.

Disposing of interface . . . At points where water is to be stopped, diverted, or stored, adequate sampling will be required even though a batching plug is used. This may be (1) adequate hand sampling and testing equipment and personnel, (2) automatic sampling of many types (recording gravitometers, dielectric constant detectors of one of several types or possible other instrumentation). A detector to indicate batching plugs' arrival is desirable but not absolutely essential. Designated steel tankage and tank fire dikes or ponds for catching the water will be essential in almost all cases.

Since the volume and per cent of contamination will not be known for sure ahead of time, some evaluation will have to be made of the interface mix. The volume of contaminated product may justify treating to separate the water and oil to permit recovery of the bulk of the oil before disposal. In any event, settling, skimming, or other separation will usually be required before dumping the water to waste to prevent pollution and incurring damage.

An old fire dike from which a tank had been removed and a temporary pond have been used to advantage to catch the interface mix. The amount of oil did not justify any attempt at recovery. However, a properly installed drain in one case and a siphon in another permitted release of the bulk of the water. This was followed by controlled burning of the oil, after which the remainder of the water was released. Piping arrangements must be planned in advance for handling any interface and temporary lines.

In some arid sections, a small slug of water has been used to displace oil from a line. The water must be moved with air or natural gas with all attendant advantages and disadvantages of their use as described later.

No advantage is seen for the use of a small slug of water. Two separation plugs would normally be used, one at the head and one at the tail of the water slug. No less contamination, no less oil left in the line and no reduced hazards can be anticipated than if air or natural gas is used to displace oil directly. Diversion and handling of the water slug on the final receiving end has all the problems and in essentially the same magnitude as if water displacement is entirely by water.

The major disadvantage of water is that its use is restricted to the period of the year that freezing will not occur So it cannot be left in lines during the winter in many areas where lines may be displaced.

The second disadvantage is in its disposal at the final receiving point and at intermediate points if the line is taken up without displacing the water. Normally, the trace of oil found along the line is too small to cause any damage. Its presence must be anticipated at all times and, when found, the amount determined. Large amounts must be impounded before spreading and picked up in tank trucks if economics warrant. Burning requires certain safety precaution and must be restricted in some areas and prohibited in other areas. The presence of only a trace of oil in some cases may cause a major disposal problem.

The third disadvantage is the repetition of cost if the water must be displaced by some other means. This extra cost is one factor that makes other methods very attractive in some cases.

In-line explosions . . . The fourth disadvantage is the somewhat unexpected hazard in displacing the water. This is based on displacing the water with air. It is assumed that if natural gas, nitrogen, carbon dioxide or other gas is contemplated that the oil would be displaced with it directly without the intermediate use of water.

At least one serious explosion occurred within a pipeline while displacing water with air. The oil in the line had been displaced with water, using batching or separation plugs. A total of 44.4 miles of 6-in. and 253.2 miles of 8-in. were displaced. The 6-in. was in four parallel lines in two sections, one 3.5 miles long and one 7.6 miles long. The 8-in. was in double parallel lines for 108.0 miles and three parallel lines of 12.4 miles. The total right-of-way distance was 131.5 miles.

Scrapers had been run through all lines regularly and the oil was displaced without any scrapers hanging or other difficulties. The oil was displaced from the south end to the north, the regular flow direction. The parallel lines were displaced separately, but pump capacity was reduced so that flow rates were very near normal for the usual operating conditions. The terrain traversed was very mountainous and rough.

After displacing the oil, two 107-cu. ft.-per-minute, 500-psi. compressors were set at a junction point of parallel 8-in. and four 6-in. lines some 38 miles south of the north end of the section displaced. Water from both 8-in. lines was displaced from this point to the north. Then the four 6-in. lines to the south were displaced. While displacing one of the 8-in. lines to the

south of the 6-in. lines, a violent explosion ripped through 2.35 miles of the 8-in.

As was the practice in all cases, a four-rubber-cup separation plug was being run between the water and air. Although there were no actual eye witnesses, from all evidence it is almost certain that the explosion started at the plug and moved backwards or to the north.

It is estimated that 41,000 bbl. of water had passed this point in displacing all of the pipe to the north. This water had had no detergent or cleaner added. It is perhaps surprising to some that enough oil would remain pocketed or clinging to pipe wall to form an explosive mixture after all the water and plugs that had passed this section. However, its existence is unquestionable. The source of ignition was never determined for sure and is probably of little consequence as several sources were possible.

In this case, the possibilities were:

1. Heat generated by the oxidation of iron sulfide or other sulfur compound left in the line by past operation. The fact that the plug was being run counter to past direction of flow and scraper runs might increase the possibility of flipping or turning a piece of iron sulfide scale and exposing an unoxidized surface. Such a piece might have been lodged in the recess in one of the screw couplings.

2. Spark, caused by a mechanical means such as rock or pieces of steel lost from scrapers run at some previous date. An old scraper blade was found near plug after the explosion.

3. Spark, from a static electricity discharge, the charge having been built up on the metal core of the rubber disk plug or having been generated by agitation of water bypassing the plug.

4. Heat generated by compression from a source other than the mechanical means used to compress the air for displacing purposes, such as an unexplainable pressure surge.

The latter two are remote possibilities. The pressure at the point of the plug was less than 200 psi. No surging is probable because an employe was bleeding water at a tap approximately 1 mile south of the plug and no pulsating or surging was noted in the stream being bled off at any time. There was also no evidence of a surge on the recording pressure gage at the compressors, which were operating at 210 psi. at the time of the explosion.

Displacement With Air

Compressed air has been used to displace many miles of pipeline using a separation plug between the air and oil. There is a serious mechanical limitation to this method as most portable compressors readily available are limited to 150 psi. or less. Hence, in displacing lines with major variations in gradient or long lines where the friction head may be high, the displacement rate may be restricted at least.

This may be partially overcome by using portable pumps to relay the oil stream ahead of the plug. This requires block valves and connections for suction and discharge lines. Installation of valves, lines, and pumping units as well as operation of the pumping units add to the cost.

The attendant fire and explosion hazard is greater than that reviewed previously. At least one case is known where 32 miles of 10-in. pipe was blown up using this method. Exact details are not known by the writer. It is reported that in this case the air pressure was approximately 100 psi. The probable sources of ignition are the same as mentioned previously.

As mentioned previously, some companies use a small (50-200 bbl.) slug of water between the air and oil. However, the washing and cleaning action probably has little to do with reducing the hazard and adds a disposal problem at the end point. Thus, this method has two principal disadvantages and little in the way of advantage.

Natural gas . . . Natural gas has been used somewhat limitedly the past few years in displacing liquid hydrocarbons. This is due largely to limited availability at the desired location. Use of this method may increase particularly in the United States as more gas lines are laid, increasing its availability.

The principal objective is to exclude air from the line to eliminate the explosion hazard. This method requires that the gas supply be available reasonably close to the pipeline bing displaced. Enough pressure to overcome elevation and friction heads of the displaced stream is desirable, and portable compressors may be used to boost pressure if warranted.

Bypassing of the separation plug by the gas should be small with available commercial plugs. It would not be objectionable or dangerous unless enough gas bypassed to cause vapor lock of the line or to cause damage to the receiving tank. With pressure gages and meters, the volume of gas entering the line can be accurately measured and controlled, and the rate of displacement similarly controlled and estimated with reasonable accuracy.

The line should be packed and full of liquid hydrocarbon before using the natural-gas method. If the line has partially drained and air pockets may be present, a dangerous mixture may result. Gas may not be available for this purpose during winter months when domestic demands are high. It certainly would not be available in most cases during winter storm periods. Should a separation plug hang, additional hazards exist if it becomes necessary to tap the line in an attempt to dislodge the scraper or to cut the line to remove the hung plug. Special precautions must be taken and an expensive loss of gas may occur if a long section must be bled down before cutting. From the standpoint of fires and explosions, the serious hazards still exist when cutting the line for takeup.

Other mediums . . . Some consideration has been given to the use of Varsol and water-solube cleaners such as various detergents and some of the alkaline degreasing compounds. To the best of the writer's knowledge, they have been used in a limited way in cleaning pipelines that are to be internally coated with a plastic lining in place against internal corrosion. This is done (1) to remove the oil and/or paraffin film and permit adherence of the coating, and (2) to remove the oil film and reduce fire or explosion hazard. Cost of material, mixing, and injection are drawbacks to the use of such material in a major displacement project.

Conclusions

The only clear-cut conclusion appears to be that the pipeline industry does not have the final solution to the problem of displacing a pipeline at this time.

The three major methods using water, air, and gas have serious disadvantages under various conditions. None of the three leaves the displaced pipe in an entirely safe condition for salvage.

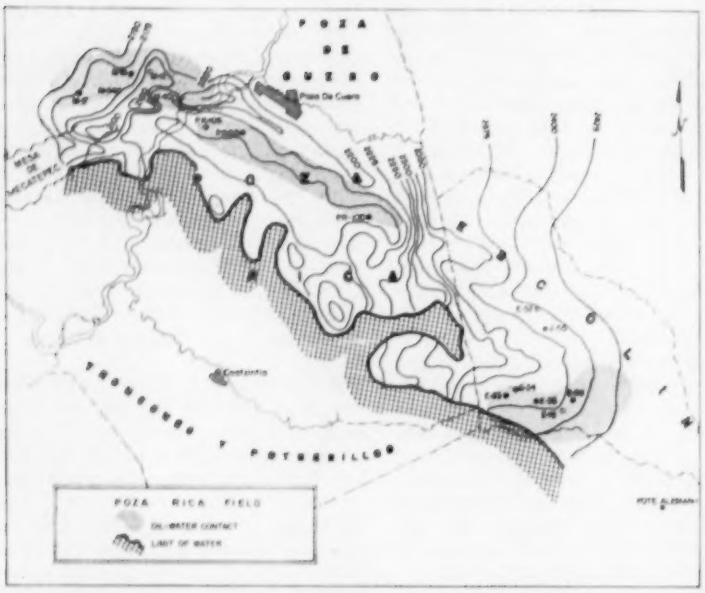
Water is the safest, particularly if it does not have to be displaced prior to takeup. Danger of damage from freezing is its major disadvantage.

Use of air is, in general, the most dangerous of all methods.

Use of natural gas is safe if properly handled during the actual displacement but it may be expensive. After the liquid is displaced, the gas cannot be disposed of in such a way that leaves a very safe line.

Batches of Varsol and water-soluble degreasing compounds have been used in a limited way, and all checking of samples done to date has shown a safe gas-free atmosphere in the pipe. But use of these is slow and expensive.

Many discussions have been held on the possible use of nitrogen, carbon dioxide, or some other nonflammable gas. However, to the writer's knowledge this has never been tried. The cost and use problems detract from their probable use.



TWO SEPARATE WATER LEVELS in the field are part of the problems of water injection. A wide variation in permeability and tight flank zones further complicate the injection program. Water-input wells are indicated. Fig. 1.

DIRECTING OPERATIONS at Poza Rica are Antonio J. Bermudez, general manager of Pemex, and Jaime Merino, general superintendent. Fig. 2.

Here is the story of Mexico's . . .

Simultaneous Gas and Water Injection

in large Poza Rica reservoir

by John C. Reidel

PETROLEOS MEXICANOS is developing significant new discoveries in other areas of Mexico. But the large Poza Rica reservoir is still Mexico's most important field. High priority is being given to development of a successful pressure-maintenance program for the field.

This is a highly interesting program from several engineering and operating standpoints:

The Tamabra producing formation is one of the largest limestone oil and gas reservoirs in the Western Hemisphere. The reservoir has been produced at 120,000 bbl. per day, but lately the production was curtailed to 107,000 bbl. daily while the facilities for a full pressure-maintenance program are completed.

Gas and water injection . . . Bottom-hole pressure is being maintained by simultaneous gas and water injection. The current rate of gas injection is 50,000,000 cu. ft. daily. Water injection is complicated by low permeability on the flanks of the field. Rate of injection was recently brought up to 120,000 bbl. per day. It is now being increased to 200,000 bbl. As the program develops, injection will be raised further to the highest possible figure.

The new pressure survey for 1954 shows that the accelerated injection program is paying off in maintenance of bottom-hole pressure.

Inclined water table . . . This is one of the most interesting features encountered in the reservoir. Two distinct water levels exist at the two ends of the reservoir. The vertical difference is 650 ft. For this reason the field is treated as two separate reservoir halves, in the water-injection scheme.

Gas Injection—Field Facilities

Petroleos Mexicanos' production department operates large-scale gas-processing facilities in Poza Rica field. With completion of new absorption and desulfurization units the natural gasoline-pressure maintenance plant is now handling 170,000,000 cu. ft. daily. The capacity is being increased to 250,000,000 cu. ft. daily. The liquids taken out by absorption are sent by pipeline to the Mexico City refinery at Atzcapotzalco.

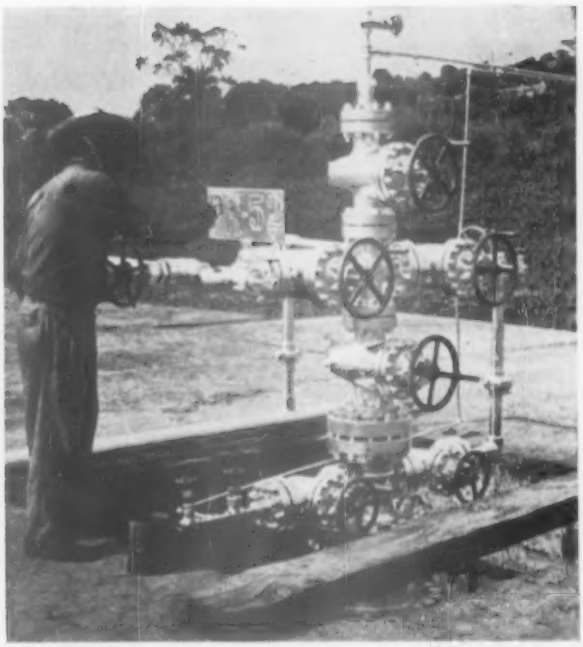
There is a sulfur-recovery plant at Poza Rica which has been expanded to a capacity of 200 tons per day.

While these are impressive facilities, extraction of liquids and sulfur is not their prime function. Ing. Alfonso Barnetche, head of Pemex's production department, says: "Primary purpose of installing gas-treating and absorption facilities at Poza Rica is to prepare a large volume of gas for repressuring of the reservoir."

Gas injection . . . In general, the section open to oil production lies well below the gas level. It has therefore been preferable to produce the oil with as uniform advance as possible of the gas zone. Gas is injected evenly over the gas cap in the center of the field, into the upper Tamabra.

Until this year the gas injection had been 20,000,000 cu. ft. per day. Pemex has now doubled this. It will be increased further to 80,000,000 cu. ft.

WELLS ARE DRILLED to about 7,200 ft. to tap the Tamabra producing formation. This limestone formation is one of the largest in the Western Hemisphere.



WELLS WERE PRODUCED until 1949 by a combination of gas-cap and solution gas drive. Both gas and water have been injected since then.

per day as new compressor facilities are tied in.

Gas leaves the absorption plant at 600 psig., that for repressuring is boosted to 2,400 psig.

Water Injection

A new water-treating plant has been installed. Primary function is to prepare water from the Cazones River for injection into the reservoir.

Original plan was to inject water into a line of wells along the northeast flank, creating a uniformly advancing water front. But permeability is low on the flank. Pemex now intends to make flank injection closer in, more toward the permeable central reefal area and below the water level, for better pressure distribution.

The water injection along the northeast flank is to be made in two parts. Major portion of the flooding will continue to be from the two ends of the field.

Field Development

As oil production was increased, the gas-oil ratios remained at essentially dissolved gas up to 1937. During 1937-1942 production was at a constant rate[1,2] and the average gas-oil ratio remained constant, even going up slightly to a value of 230. This was largely due to shut-in wells with no squeeze jobs.

Workovers were started in 1944-45. Rate of production was increased and the gas-oil ratios declined down to a dissolved gas-oil ratio of 160. With large increase in production through 1949 the field came down to critical liquid saturation. Since 1951 more wells have been drilled but these did not bring in proportionate production since they are on the flanks of the upper Tamabra, in the area of low permeability. Production at present is 75 per cent from the lower Tamabra and 25 per cent from the upper—roughly in proportion to the permeability.

With the repressuring program in effect—gas going into the upper Tamabra and water into the lower Tamabra—the average gas-oil ratio is now 169 in the upper and 329 in the lower Tamabra, giving an over-all average of 280.

Gas lift was initiated 2 years ago on 25-30 wells. New wells on the flank are on pump. These can produce up to 40 per cent water cut. A program of electrification for the whole field is being carried out by stages, moving toward the central area. Conversion to mechanical pumping will permit production of a higher water cut and greater recovery through water flood.

Poza Rica Geology

Poza Rica field is located 110 miles northeast of Mexico City. It is 22 miles from the Gulf of Mexico coast. Geologically it is in the Tampico embayment. The field is associated with an anticline running northwest-southeast.

In geologic age the reservoir is part of the Tamaulipas and the El Abra limestones, hence the name Tamabra. The Tamaulipas outcrops in the sierra of that name. The El Abra forms the reservoir of the Golden Lane. Salas[3] has dealt also with the overlying Cretaceous and Tertiary beds. Illing[4] more recently has reviewed the geology of the Tamabra.

The Tamabra can be divided into an upper and lower section and an intermediate compact zone referred to as the "f" horizon.

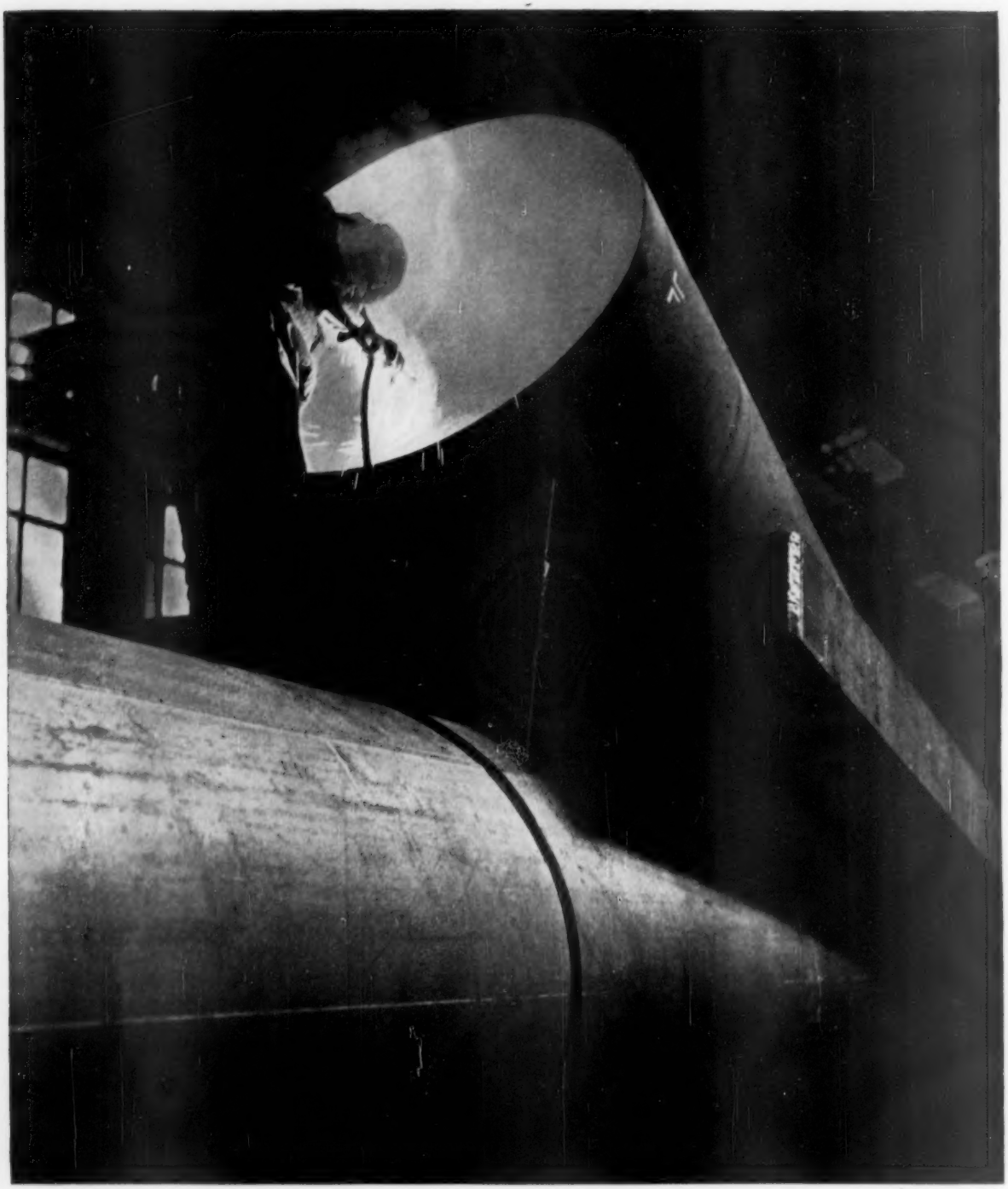
Upper Tamabra shows much vertical variation but little lateral variation. It varies vertically not only from compact to porous types but also from dolomitic to pure limestone. The upper Tamabra even contains a consistent shale bed. The typical lithology can be summed up this way: "finely porous but poorly permeable calcarenite composed of skeletal calcareous silts and fine sands."

Lower Tamabra, located between the "f" horizon and the Tamaulipas, is the main producing horizon. It is much the same as the upper Tamabra on the flanks but ordinarily more dolomitic. Cores taken in the axial portion of the field commonly show highly vugular, strongly dolomitic reefal lithology.

The strongly reefal zones generally occur in the upper half of the lower Tamabra but may also be found lower down. Dolomitization is less marked on the edges of the field but is very strong in the reefal section.

The impervious zone known as the "f" horizon is the most consistently identifiable horizon in the Tamabra.

Logging . . . Since 1949 several detailed logging methods have been used. S.P. curves, long and short normal resistivity



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curves, a long lateral, a limestone curve and MicroLog of the Tamabra have been made for all new wells, except in the few sections drilled with oil-base mud.

Radioactive logs were introduced in 1950. These are used on all new wells and workovers. Knowledge of the distribution of porous and nonporous beds throughout the field has increased greatly as a result of neutron curve study.

"Bottom-hole pressure is being maintained by simultaneous gas and water injection . . . 50 million cubic feet of gas and 200,000 bbl. of water daily. As the program develops, injection will be raised to the highest figure possible."

Porosity and permeability . . . Laboratory measurements of core porosity usually run between 8 and 20 per cent —14 per cent can be taken as a good average for the Tamabra.

Permeability values are generally under 5 md. for the porous parts of the upper Tamabra (typically recrystallized calcareous fine sands and silts). The usual range is between 0.5 and 2 md.

There is greater variation in the lower Tamabra. Permeability is often greater than 1 darcy in some of the most cavernous developments in the axial part of the field. Such high values are found sporadically in the central area almost down to the base of the Tamabra.

But on the flanks the story is different. Here average values ordinarily do not exceed 5 to 10 md. and then only in strongly dolomitic intervals. The base of the Tamabra in the flanks shows ordinarily only a trace of a millidarcy. By indirect methods[6], an average permeability of 45 md. for the whole reservoir has been computed.

Oil-Water Contact

In early work at Poza Rica it was assumed that the oil-water contact was uniform. But later it was found that clean oil exists much deeper in the Escolin area. It was thought that there were two separate water tables perhaps separated by some vertical barrier[8].

Since then much more has been learned about the water level. Accompanying contour map of the oil-water contact was prepared by combining: (1) "long lateral" resistivity curve information, and (2) all available production data, with (3) knowledge of permeable and compact zone distribution from cross sections.

The oil-water boundary is a transition zone, which of course makes it even more difficult to determine. However, it is now definitely known that the water level in general drops to the southwest. The water table reflects to some extent the shape of the reservoir itself. But there are two distinct water levels at the two ends of the field. These are joined by a narrow zone with a very steeply tilted interface.

The situation has led to the recommendation that the two halves of the reservoir be treated separately in the new water injection scheme. Since the Poza Rica reservoir does not have uniform lateral and vertical permeability water cannot be injected peripherally to produce a uniformly advancing water front as in the ideal case.

Specifically, the present Poza Rica water-flooding plan is to inject principally from four areas. These are: (1) from the Mecatepec at one end, and (2) the Escolin at the other end of the field, and (3) a line of input wells along the northeast flank broken into two parts opposite the belt of steeply inclined oil-water contact. These four areas are so located that the lower Tamabra is entirely within the water zone.

Major water flooding will be from the two ends where existing input wells show high capacity. Injection rates will be lower on the flank of the field where the lower Tamabra is less permeable. Injection wells will of course be spaced in accordance with local distribution of permeability.

New Water Plant

The scheme of water flooding to be adopted requires a water-injection system with total capacity of 200,000 bbl. per day. A water-treating plant has been installed to provide this capacity currently. With addition of more pumping equipment the plant will provide in the future over 300,000 bbl. daily of deaerated, chemically treated water. By far the largest portion of this capacity is for flooding of the reservoir. Relatively smaller quantities are supplied for process use in the Poza Rica plants and to the town of Poza Rica.

The water plant prepares a clear, potable water, chemically stable and compatible with the reservoir fluids. Principal equipment is: (1) settling basin, (2) precipitators, (3) gravity filters, and (4) deaerators. Water comes from the Cazones River to the settling basin. Here as much as possible of the heavy sediment is removed (2-3 days' retention).

Precipitators consist of a centrally located mix compartment, flocculation zone, and upflow sludge filter compartment. There are two precipitators in parallel.

In the mix chamber lime is added for pH control. Chlorine is fed to aid in oxidation of iron and to control growth of microorganisms. Aluminum sulfate is added as a coagulant to maintain a sludge blanket in the precipitators and to provide a small amount of floc formation in the water as it goes to the filters.

Filters . . . There are four gravel and sand filters in parallel. Their function is to remove the floc and suspended matter. A rotary surface wash system provides backwash and helps clean the upper layers of the filter sand.

Deaeration . . . There are two deaerators in parallel. The dissolved oxygen is removed in order to minimize corrosion and possible precipitation of sulfur on contact with H_2S in the reservoir. Hexametaphosphate is added at the suction to the deaerator charge pumps. This is to stabilize the water and prevent any further precipitation of solids in the distribution system or underground in the formation.

Acknowledgment

Appreciation is expressed to Petroleos Mexicanos for permission to publish this article, and in particular to Ing. Jose Colomo, assistant manager of Petroleos Mexicanos, and to Ing. Alfonso Barnetche, head of the production department. Ing. Juan Hefferan, head of reservoir engineering, was very helpful in preparation of the article. Ing. M. Martinez Rios aided with geology and the oil-water contact map.

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THE FOREMAN'S PAGE

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JOB IMPROVEMENT FOR THE PROCESS FOREMAN—29

How Much Do You Know About Rotary Pumps?

THE rotary pump combines the rotary motion of the centrifugal with the positive-pressure characteristics of the reciprocating pump. Like the reciprocating pump, it is a positive-displacement device that delivers a given quantity of fluid with each revolution. It is self-priming and gives practically constant delivered capacity regardless of pressure.

Q. What makes rotary pumps so popular?

A. The range of speeds on rotary pumps is much higher than usual for reciprocating pumps. This permits a direct-connected motor drive in most cases. Greatest use of the rotary pump is in handling viscous fluids, but it will pump practically any fluid that will flow. It is for these reasons, and the fact that it is keeping the pipelines of many processes full which would otherwise be unable to function, that the rotary pump is known as the workhorse of industry.

A rotary pump consists of a fixed casing containing gears, cams, screws, plungers, or similar elements actuated by rotation of the drive shaft.

There are six basic types of pumps in this classification: gear, vane, screw, cam and piston, shuttle block, and multiple piston.

Q. What's a gear-type rotary pump and how should it be operated?

A. The gear type, which is the most common, consists of the external gear including spur, helical, and herringbone teeth; the lobular or impeller type; and the internal gear. Depending on the design and service, gear-type pumps may be furnished either with or without timing gears. All have constant-displacement characteristics. Several gear-type pumps are illustrated in Figs. 1 and 2.

Since the clearance between the element and case is extremely close and the material being pumped acts as a cooling agent, the pump should never run dry. This will cause extreme heat due to friction, and the element and case will fuse together.

These pumps are not designed to handle any solids and should, as a rule, have strainers in the suction. They are usually powered by an electric motor or steam turbine, and they run at a fairly high speed.

Starting a Gear Pump

1. Check all flanges and glands and be sure they are tight.
2. Close all bleeders.
3. Open the suction valve and allow the liquid to enter pump. Turn the pump by hand to be sure it is free and also to displace the air in the pump out a bleeder on the discharge. This bleeding should continue until the case temperature is close to the material to be pumped.
4. Check all oil and water connections. Be sure they are in operation.
5. If turbine-driven, warm the turbine with steam until all condensate is out.
6. Be sure the exhaust steam valve is open.
7. Open the discharge valve and be sure lineup is completed to the tank or vessel to which you are pumping.
8. Start the motor or turbine and closely observe discharge pressure to make sure the pump is pumping and there are no blinds or valves closed in the discharge line.

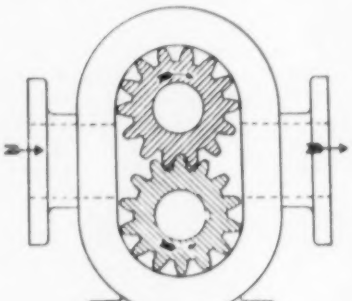

Fig. 1—External gear pump.

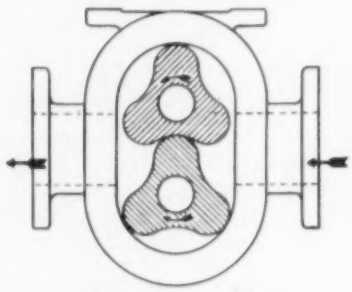

Fig. 2—Three-lobe pump.

Gear Pump in Operation

1. Check the bearings and packing for excessive heat, vibration, or lack of lubrication.
2. Check the pressure gage at discharge and be sure the pump has suction at all times.
3. Check the water glands and be sure water is going through them.
4. Check undue vibration or noise. If the cause cannot be eliminated, shut the pump down and call a mechanic.

Shutting Down a Gear Pump

1. Stop the motor or turbine.
2. Close the suction and discharge valves.
3. Open the bleeders on the liquid end.
4. Open the bleeders on the power end.
5. If it is steam-turbine-powered, take all precautions to prevent any freezing.
6. If the pump is to be worked on, the oil or water connections must be shut off and drained.
7. If the pump is to be removed, blinds should be installed at the suction and discharge.

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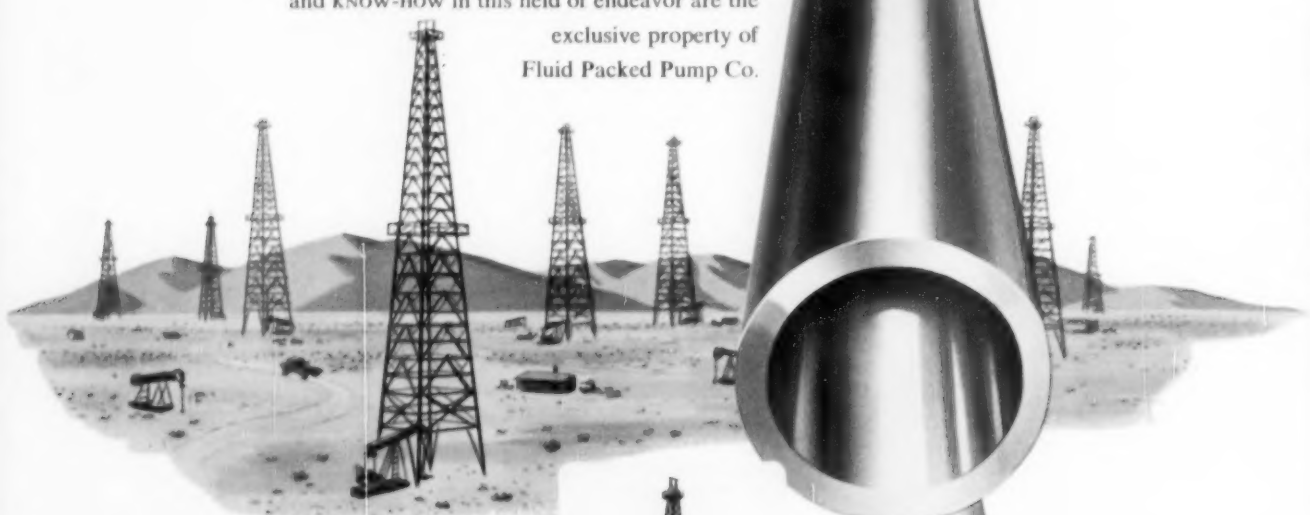

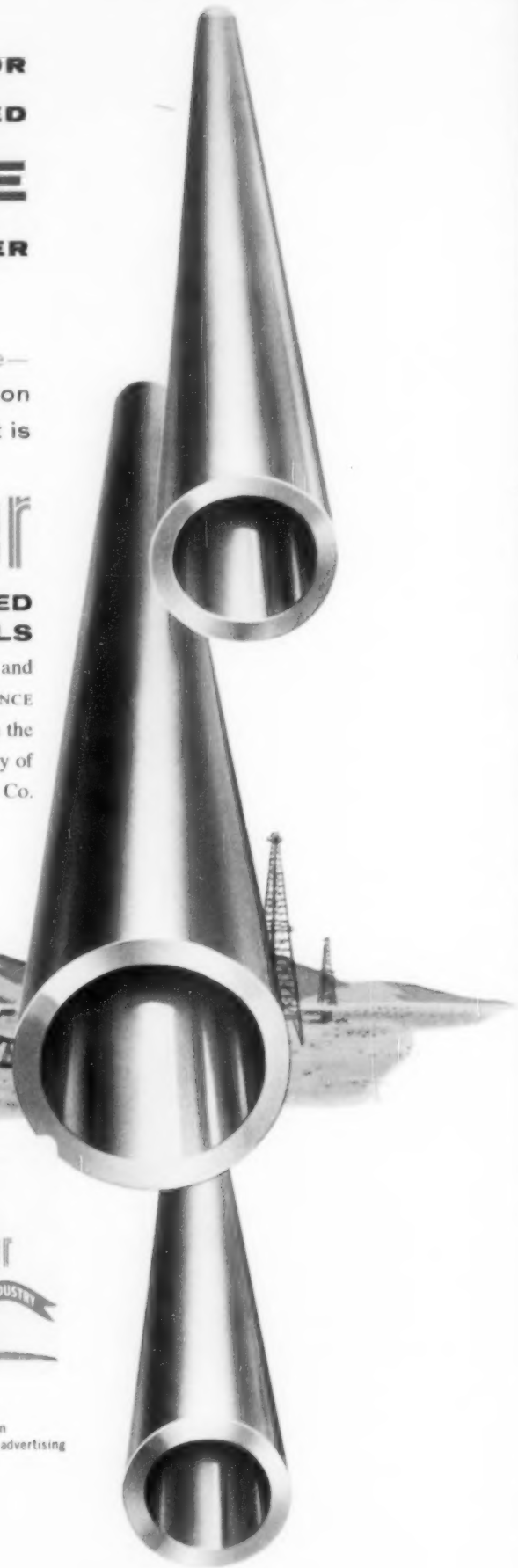

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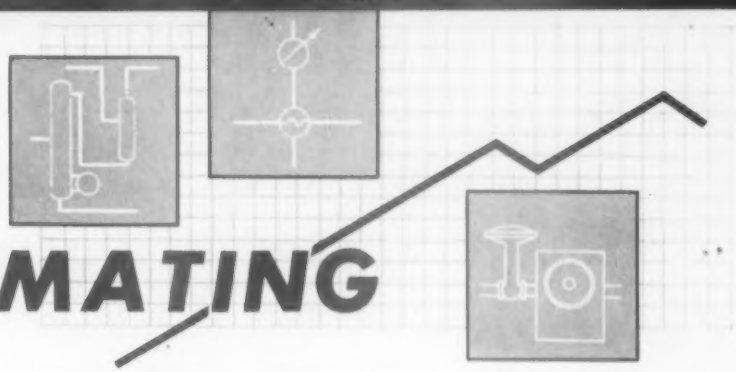

COSTIMATING

1. Construction Steel Price Trends

by W. L. Nelson
Technical Editor

ENORMOUS amounts of steel are used by the petroleum industry. The cost of steel since 1946 has increased somewhat in proportion to other costs but in mid-1955 sharp increases occurred. The effect of this increase has not yet been fuly felt.

Although iron or carbon steel at the mill is worth only 3-4 cents per pound, the rolling, piercing, etc., conducted at the mill raise the price to 4-8 cents per pound. This also is a low cost but with final rolling, forming, and fabricating into even simple vessels or equipment, and with installation costs, the price rises double to tenfold (see tabulation this page).

Example . . . The cost of a 23,000-lb. carbon-steel vessel during 1946 amounted to:

Material, approx.	15.0 ct./lb.
Labor, approx.	0.8
Total	15.8 ct./lb.

If flanged connections, manholes, instrument collars, etc., are included, and if the vessel is stress relieved, etc., the cost may be 40 per cent greater or 22.1 ct./lb. total.

If the carbon steel vessel is fitted with connections, and examined, the cost (1955) will be approximately:

$$55{,}600 \times 1.40 = \$7{,}840$$

COST INDEXES (1946 = 100)[1,3]

	Plate steel	Boiler tubes	Steel (finished)	Structural shapes	Iron and steel	Labor	Nelson index[2]
1946	**100**	**100**	**100**	**100**	**100**	**100**	**100**
1947	117.5	115	118.9	113.4	121	113	117
48	140	131.3	135.7	138.0	141.1	128	132.5
49	134.8	140.7	146.5	151.2	150.2	137	139.7
50	136	149.5	153.7	162.3	152.9	144	146.2
51	156.1	163.3	166.3	172.3	166.7	152	157.2
52	153.4	168.8	170	176.2	168.5	163	163.6
53	150.3	188.3	182.7	185.7	177.4	174	173.5
54	147.3	199.4	187.1	193.4	179.6	183	179.8
55, est.	154	220	202	212.0	197	190	184.5

COST OF CARBON STEEL IN VARIOUS FORMS, CENTS PER POUND[1,2,3,4,5,6,7]

	1946 costs (see indexes this page)[1]		
Kind of steel or service—	M.	L.	M. & L.
Mill, composite	2.68		
Structural (I beam)	2.32		
Plate	2.47		
Sheet, 11 ga.	3.45		
Sheet, 24 ga., galv.	4.05		
Fence wire and nails	3.5-3.8		
Pipe, ¾-in., black	4.0		
*Vessels, cyl., without connections			
500 lb. weight	30-50	4.0	34-54
1,000 lb. weight	25-40	3.5	*29-43
5,000 lb. weight	17-28	2.2	*19-30
10,000 lb. weight	13-25	1.5	*14-27
20,000 lb. weight	10-20	0.8	*11-21
50,000 lb. weight	8-16	0.5-1.5	*9-17
100,000 lb. weight	8-15	1.0-1.5	*11-15
Field fabricated	12	8.5	21
†Tanks, A.P.I. flat-bottom cone-roof fabricated and erected			
10,000 lb. weight (300 bbl.)	3	35	28
12,500 lb. weight (700 bbl.)	3	20	23
25,000 lb. weight (1,400 bbl.)	3	15	18
55,000 lb. weight (4,500 bbl.)	3	11	14
115,000 lb. weight (13,000 bbl.)	3	8	11
200,000 lb. weight (25,000 bbl.)	3	7	10
Forgings—nozzles, flanges, manholes			50-100
Pipe still bends, 1½ in.			115-138
Pipe still bends, 6 in.			32-38
Stacks, guyed in place	14-20	3.5	17-23
Breeching connections to stack, etc.	30	11	41
Galvanized iron, 22-24 ga., corregated	8-9	4-5	12-14
Condenser boxes, fabricated			7-9
Condenser boxes, field fabricated	7-15	10-12	17-27
Reinforcing for concrete	3-6	1.5-2	5-7
Structural steel, exposed	7	5	12
Pump houses	8-9	2-3	10-12
Pipe stills	9-10	3-4	12-14
Small parts	8-13	2-6	11-18
Tower-tray supports	10	33	43
Handrails, platforms, ladders, etc.	8-13	2-8	10-19
Pipe—pipelines	4.7-5.3		
Butt and lapweld piping	15-7		
Spirat welded	8		
Seamless or tubes	17-10		

*With connections, stress relief, X-ray inspection, etc., 26 per cent more for largest vessels and up to 6 per cent more for the smallest. †Add 5 per cent for full penetration welding, also 5 per cent for nonstandard dimensions. ‡Add 10 per cent for waste. §Add 2.5 per cent for each foot past a length of 24 ft.

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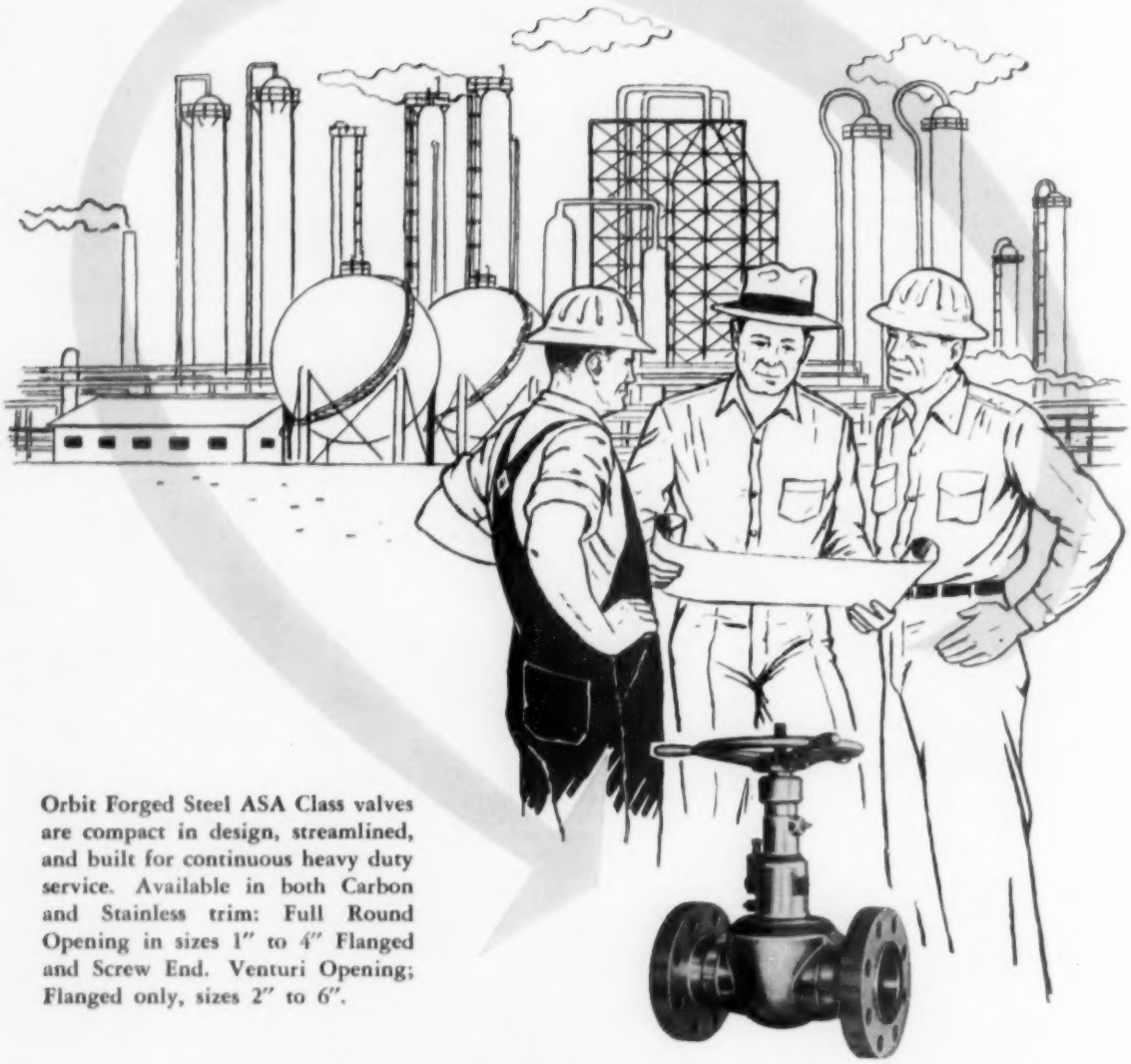

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by N. E. van Fossan

UNDERGROUND STORAGE—7

Casing-Setting Problems in Drilling Storage Wells

IF casing is successfully set on top of the true cap, the next step involves drilling out from under that casing and into the loss-of-circulation zone almost invariably encountered in upper reaches of the calcite cap (Fig. 3). When this loss-of-circulation zone is encountered, most operators will continue to drill without returns — that is, they will simply pump drilling fluids down the drill string and let them sweep the cuttings into the loss-of-circulation area.

After anhydrite has been penetrated far enough to give a good sound casing seat with enough cement sheath to block the third casing string from the loss-of-circulation zone, it is then set and cemented. Some operators set a full string. Others set only a liner which overlaps into the "top of cap string" with a packoff (Fig. 4). Casing strings are cemented back to the loss-of-circulation zone in either instance.

The fourth operation involves drilling out from under "base-of-cap" casing string. The massive anhydrite bed is penetrated to the top of the salt. At this point, further complication can arise from both unconsolidated anhydrite sand and solution channels. These channels result from the intermingling and later dissolving by ground waters of salt fingers and salt pockets which exist in the transitional phase between the main salt body and the main cap rock.

If the salt mass is penetrated without loss of circulation at the transition zone, drilling is continued until the salt mass has been penetrated an adequate distance, and the fourth casing string is set. If a loss-of-circulation zone is encountered, similar drilling procedures are carried on as in the loss of circulation in the upper portion of the cap, but penetrations are made further into salt mass to give increased cement sheaths between the casing seat and the loss of circulation zone.

Author is with Texas Natural Gasoline Corp. Paper presented at N.G.A.A. Dallas meeting, 1955.

Cementing Procedures

Cementing procedures used in the planting of the final casing string are most important. Several problems are involved in the setting of a casing string in a salt section. Salt will go into solution with the water used in mixing cements. All cements shrink. The salt mass is plastic. And the insolubles that may be contained in the salt might possibly have a bad influence on the strength or setting characteristic of the cement.

The most acceptable practice in setting this casing string seems to be using common cement which has first been dry mixed with granular salt in proper proportions and which is then mixed with saturated salt water. This results in a supersaturated solution mixture of the cement slurry, and it should take no other solubles into solution.

This method will result in the least possibility of leaving a parting plane between the salt body and cement due to the dissolving of the salt mass. There are some grounds to believe that a cement slurry of this type will have less tendency to shrink during dehydration.

The cement job is generally tailed in with resin cements and sometimes with plastic, both having the nature of nonshrinkage and nonaffinity to the salt mass as far as solubility is concerned. Perlitic additives are generally used in the major mass of the cement job to lighten the slurry. And loss-of-circulation materials are added in generous amounts if the weight of the cement column should break down the rather ticklish transition zone between cap rock and salt body.

When the cement job has been completed and the cement has been circulated to the surface, it is allowed to set long enough to gain its full strength. If loss-of-circulation zones have been encountered at the interface of the anhydrite and salt, and if it is believed that a cement sheath will not be obtained above the loss of circulation zone, the final casing string should be checked most carefully for leaks of any type. Because if that string is not perfect, product leaks will immediately be dumped to the existing loss-of-circulation zone.

Some operators, in fact, insist on a welded string. The author doubts that this is of much benefit unless a threaded and collared string is run, and then welded as an extra precaution. Some operators dope and wrap, or add additional metal, to that portion of the casing string which sets across the loss-of-circulation zone. This is done because it is generally felt that there is an actual fluid flow through this area which creates an intensive corrosion condition.

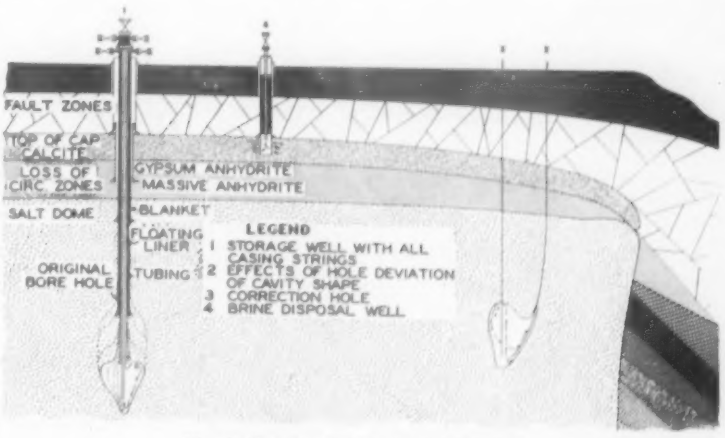

Fig. 4—Details of salt-dome storage wells.

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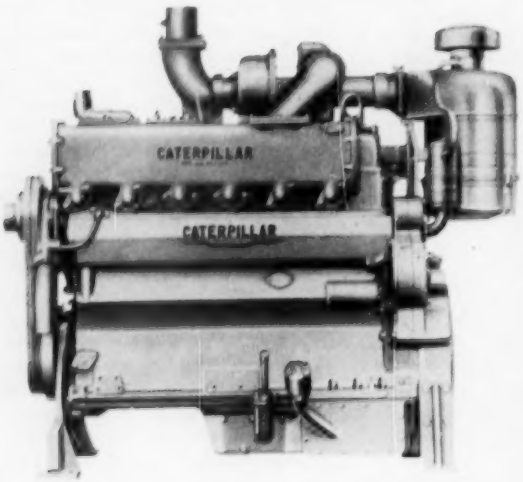

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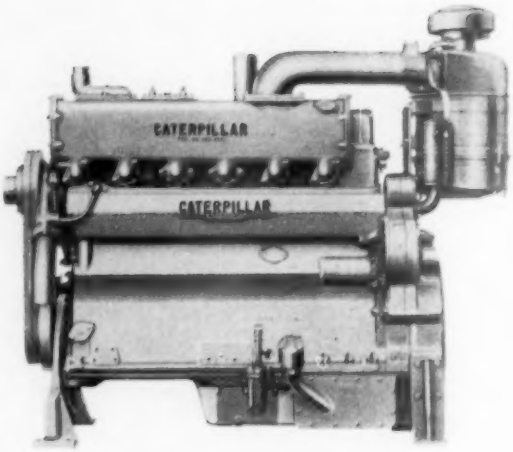

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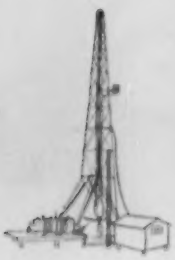

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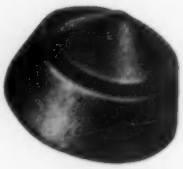

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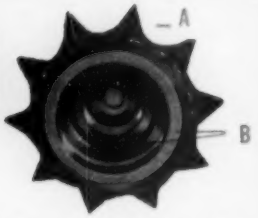
A Balanced bearing design and B accurate machining for precision assembly.



A Correct heel design and hard facing B Bearing races precision ground.

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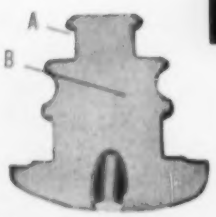
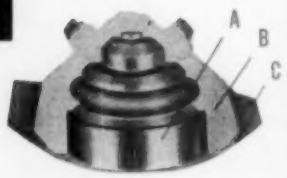


Horizontal section of Leg Journal shows
A hard case for long wear
B tough, ductile core which gives strength and shock resistance.



Cone section shows careful balance between
A bearing size
B shell thickness
C tooth depth

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Among the

Drilling Contractors

Power Rig Drilling Co., Lafayette, La., is keeping a rig running for F. A. Callery, Inc., of Houston, in the Scott area, 5 miles west of Lafayette, in Lafayette Parish, Louisina Gulf Coast. Newest contract is for an 11,000-ft. outpost test north of the field. It will be the operator's 2 Broussard. Location is in 35-9s-3e.

Bass Drilling Co. has a rig working for Sinclair Oil & Gas Co. at a wildcat location in southern Kenedy County, 10 miles north of Raymondville, and 1 mile north of the Willacy County line, on the lower Texas coast. The test, 1 M. F. Garcia, in the San Juan de Carricitos Survey, is scheduled to be carried to 12,000 ft.

Jack Halbert is drilling for R. W. Fair and others in 1 Campbell estate, a 5,200-ft. wildcat test in the H. E. Davis Survey, 3 miles northwest of Neches, in Anderson County, East Texas.

Offshore Drilling Co. is under contract to Southern Production Co. for a 10,500-ft. test to be drilled at a wildcat location 3½ miles northwest of Raceland field, in Lafourche Parish, southeastern Louisiana. It will be Southern's 3 Godchaux, in 36-15s-18e.

Grace Drilling Co., Houston, is scheduled for another Austral Oil Exploration Co. test in the Anse La Butte area of St. Martin Parish, Louisiana Gulf Coast. The new operation, at 1 Donlon, in 71-9s-5e, is east of production. It is a 9,000-ft. job.

J & C Drilling Co., Refugio, Tex., is drilling on another deep wildcat test Superior Oil Co. is putting down northeast of Sinton, in Patricio County, South Texas. The new operation is at 4-2 Minnie Welder, in the C. J. Francisco and E. Portillo Survey, 2½ miles from town, and also from nearest production. Drilling is set up for 8,500 ft.

Neil Drilling Co., Corpus Christi, and **Allen & Morris**, San Antonio, are the respective contractors on two wildcat tests Southern Minerals Corp. is starting in southern Victoria County, South Texas. Neil's rig is on 1-A Smith, a 4,500-ft. contract in the D. Garcia Survey, a mile east of Dernal. Allen & Morris' rig is drilling 1 Laura Fagan estate, in the Jose Maria Valdez Survey, 7 miles southeast of McFaddin, on the Refugio county line (San Antonio River). It is projected to 8,600 ft.

Brown Drilling Co., Long Beach, Calif., has a rig under constract to Geochemical Surveys for a 9,000-ft. Eocene test 4 miles southeast of Corcoran, in Tulare County, northern California. The operation is listed as 62-9 Wheat, with spot location in 9-22-23.

Camay Drilling Co., Compton, Calif., is drilling for Southern California Petroleum Corp. at a wildcat location southwest of Temescal field, in Ventura County, southern California. It is a Miocene test at 1 Hidden, in 4-4n-18w.

Wilson Drilling Co., Jackson, Miss., is drilling for John S. Callon at a wildcat location northeast of the new North Sunnyside field, in southwestern Jefferson County, Mississippi. It is a 6,200-ft. Wilcox test at 1 Shelvy-Saddler in 18-8n-1w. The area is 12 miles northeast of Natchez.

Woolf & Magee, Tyler, Tex., have taken an interest with Clarence W. Meadows and associates and will drill a deep wildcat test in Central Madison County, Mississippi. Location, at 1 Ray, in 12-8n-2e, is 3 miles south of Canton, and about 15 miles northeast of Jackson. Objective is the Lower Cretaceous - Hosston formation about 11,000 ft.

Diablo Drilling Co. and **Brazell & Wrather**, both of Denver, split on two drilling contracts awarded by Elpasgar Oil Co., also of Denver, for tests in the Denver-Julesburg basin. Diablo is drilling Elpasgar's 1 Williams, a 4,300-ft. "J" sand test in 12-1n-51w, 8 miles southeast of Akron, in Washington County, Colorado. A Brazell & Wrather rig is on the company's 2 Vavra, a 7,000-ft. "J" sand test, in 3-15n-58w, in northwestern Kimball County, southwestern Nebraska.

Crow Drilling & Production Co., Shreveport, is to drill a Lower Cretaceous wildcat test for **Sunnyland Contracting Co.**, of Rayne, La., in George County, southeastern Mississippi. It is a 9,000-ft. test, carried as 1 U.S.A., with spot location in 21-1s-8w, 4 miles southeast of Merrill. Sunnyland has a new contract job of its own under

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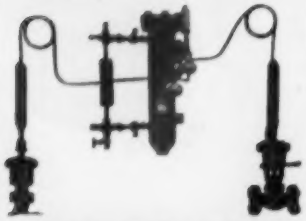

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way in Wilkinson County, southwestern Mississippi, where it is drilling for Serio-Punches Oil Co. and Thomas J. Glennon at 1 Wallace, in 20-2n-1w, 4 miles northeast of Woodville.

R. L. Gibson Drilling Co., Kilgore, Tex., has a rig on a wildcat location 2 miles southwest of Troup, in Smith County, East Texas. It is a 4,800-ft. test being contracted for Doug Procter. Location is at 1 Martin, in the William George Survey. It is 3½ miles southwest of Good Omen field.

Norton Drilling Co. has taken on a contract for a projected 13,000-ft. wildcat test Austral Oil Exploration Co., Inc., will drill north of The Texas Co.'s deep Lafitte field, in Jefferson Parish, Coastal Louisiana. Drilling will be at 1 LL&E-Lafitte, in 5-17s-24e.

Southern Six Drilling Co., Opelousas, La., will drill a 6,000-ft. outpost test at Port Barre, St. Landry Parish, southern Louisiana. It is a contract job for Harvey Weir & Sons, of New Orleans. Location is at 1 Watkins, in 4-6s-5e.

Big "6" Drilling Co., Houston, has moved its rig from Morris K. Womack's wildcat test, 1 Hutchins-Sealy, 5 miles northeast of Conroe, in Montgomery County, Texas Gulf Coast, to wildcat location 1 mile southwest of Conroe, where it is drilling another test, 1 Oualline et al, for the same operator. The new operation, in the K. Hyman Survey, is contracted to 6,500 ft. The first test was dry at 5,020 ft.

Shoreline Drilling Co. is under contract for another well Natural Gas & Oil Co. and W. C. Feazel have scheduled for the Stella area, southeast of New Orleans, in Plaquemines Parish, southeastern Louisiana. The well, projected to 10,500 ft., will be the company's 1 State, with location in 2-15s-24e. It is the second well for the company, the first having been completed early this month as a new-pay gas-discovery well with producing interval at 11,370-90 ft.

Tri-State Drilling Co. is getting under way on another deep test it has contracted to drill for Amerada Petroleum Corp. in southern Florida. The new location, the third for Amerada in that part of the state, is in northwestern Indian River County. It is 4½ miles northeast of Lokosse, and 35 miles north of Okeechobee. Designation is 1 Mitchell, in 28-31s-35e. Amerada's other two tests, both recently abandoned, were in Okeechobee and Palm Beach counties. The former went to 10,838 ft., and the latter to 11,030 ft.

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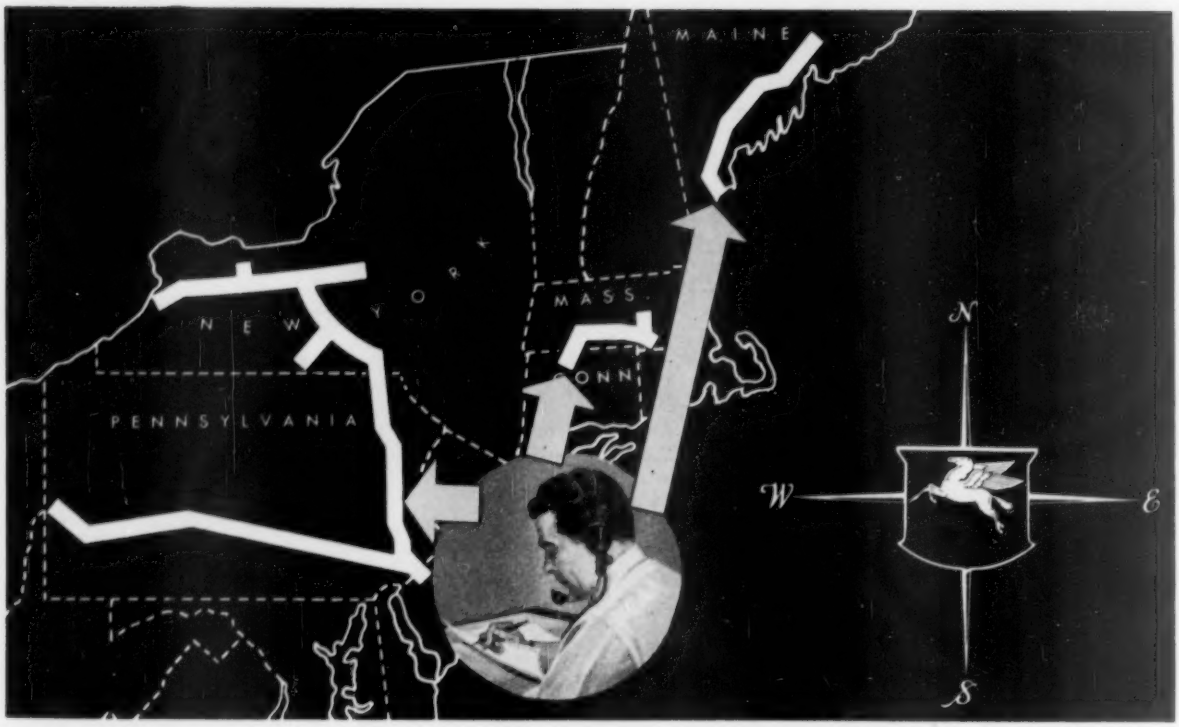

The dispatcher receives hourly reports on pressure, temperature, gravity, and rate-of-flow from each station on three pipe lines.

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One dispatcher controls three eastern pipe lines with Bell System private line telephone service

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How Phillips is whipping the problems involved in . . .

Batching gasoline through crude lines

by C. N. Adams

Natural gasolines are now being batched successfully through 100 miles of Phillips' pipeline system. But batching wasn't always successful. This articles gives the steps taken to reduce to 3 per cent the volume of contaminated natural gasoline in each batch.

NATURAL gasoline from field plants often must be shipped by truck or tank car when there is no products line from the plant. The high tariffs involved then make the gasoline an expensive item for blending purposes. If crude-line capacity is available in the area, this may be avoided by batching the natural gasoline through the crude line.

Such movements are technically feasible and offer economical advantages to the shipper. But only if contamination of the gasoline can be kept to a minimum. Otherwise, expensive reprocessing of the contaminated natural gasoline will render the shipping method unsound economically.

To achieve a low percentage of contamination, one pipeline company found it necessary to make certain changes in operation and to embark on an intensive program of cleaning and keeping clean the crude line involved.

Initial trials . . . Batch shipments of natural gasoline through a common-carrier crude line in Oklahoma were begun in 1951. Shipments originated at the tank farm of a gasoline plant and were delivered to a crude-oil terminal more than 100 miles away. Product mixing was so great during the first batch shipment that it was necessary to reprocess all of the gasoline.

At first, 25,000 to 50,000-bbl. slugs of natural gasoline were pumped into the crude line without any special internal-cleaning program or use of any separating medium at the interfaces. The greater part of each shipment was discolored by crude oil in solution and foreign material in suspension.

The cost of reprocessing the contaminated natural gasoline was considered excessive by the shipper. As a result, the shipper elected to move the natural gasoline by another means. This loss of revenue to the pipeline caused it to take steps to provide better service. Upon assurance by the pipeline carrier that a satisfactory solution would be worked out, the business was returned.

Author is assistant district superintendent, Phillips Pipe Line Co., Odessa, Tex. Paper was presented at the American Society of Mechanical Engineers' petroleum mechanical-engineering conference, New Orleans, 1955.

To reduce the percentage of each batch received as contaminated natural requiring reprocessing, a series of studies was begun from which the background for this paper is taken. The primary objectives were to maintain Saybolt color and A.S.T.M. gum content at destination equal to that at origin point.

Character of Contamination

What is contamination? Contamination in this case resulted from the mixing of natural gasoline with crude oil and from the suspension in solution of foreign matter in such proportions as to lower the Saybolt color index or to increase the A.S.T.M. gum content, or both.

Factors affecting contamination . . . Studies showed that the factors affecting contamination are: (1) internal condition of the pipe; (2) method used to clean the line internally prior to gasoline shipments; (3) medium used for separation of the interface; (4) the rate of flow during movements; and (5) various techniques of operation.

The internal condition of the pipe was the outstanding factor affecting contamination. The line through which these batch shipments were made was laid in the late 1920's of second-hand 6 and 8-in. pipe and had received only the repairs necessary to provide continuous operations. It was generally known that internal pitting existed and that many areas had been half-soled or full-soled during line repairs.

Although it was not possible to change the internal condition of the line without engaging in an extensive pipe-replacement program, it was apparent that these conditions must be recognized. For they affected the deposition of paraffin on the pipe walls, the selection of cleaning equipment and separating mediums, and the technique of operations.

Methods Used to Decrease Contamination

Internal cleaning . . . Experience with the first few shipments of gasoline pointed to the need for a method of cleaning the line prior to each shipment. Removal of the scale, rust, and dirt imbedded in the congealed paraffin on the pipe walls would be a forward step toward reducing contamination. Therefore the selection of the type of scraper best suited for this purpose was the first problem considered.

Before the movement of natural gasoline was begun, a knife-type scraper had been run at infrequent intervals to remove the paraffin. As the first step after batch shipments were begun, a schedule for running the knife-type scraper was established. Then a few days before the gasoline shipment, one knife-type scraper was run in the usual way. This helped a little, but it did not significantly decrease the percentage of contaminated natural delivered.

Use of a wear-compensating, brush-type scraper was considered. But presence of many miter welds in the line prevented use of those available on the market. This problem was overcome when a manufacturer made a swivel-joint model. Using these swivel-joint, wear-compensating, brush-type scrapers an intensive internal-cleaning program was begun.

Several schedules were tried, varying the time by which each scraper preceded the gasoline and the frequency with which scrapers were run during periods when no gasoline was moved. The results were gratifying. The percentage of contaminated natural was reduced to less than 35 per cent of the

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total volume received during these trials.

Through continued experimentation, it was found that the ideal scraper program involved the use of three brush-type scrapers run 24, 4, and 1 hours prior to the front interface of the crude oil and gasoline, plus one brush-type scraper per week when no gasoline was being moved.

In an attempt to improve the efficiency of the internal-cleaning program using brush-type scrapers, two successive shipments were preceded by slugs of crude oil having higher gravity than that ordinarily moved through this line. This apparently reduced the amount of contamination. But due to the inability to correlate the results with information gathered on other shipments and the unavailability of high-gravity crude stock, no definite conclusion regarding its effectiveness was possible.

Mixing at Interface

A project intended to eliminate product mixing at the interface was run concurrently with the scraper program. Rubber batching plugs to separate the crude oil from the gasoline seemed to maintain a minimum volume of mixture at the interface. Although this appeared to be the answer, the gum content of those shipments made with batching plugs was appreciably higher than those batches where no separation plugs were used. This was attributed to increased pipe-wall scrubbing by the rubbers on the batching plugs which caused imbedded paraffin to be loosened and dissolved by the gasoline.

Since interfacial mixing is dependent on the rate of flow, there was less contamination of product during periods of pumping at the maximum rate. During several shipments, shutdowns were necessary for repair of line breaks. Interfaces of these batches showed marked increase in product mixing and discoloration of gasoline.

Another factor influencing mixing at the interface was the insertion and removal of scrapers at locations not having standard sending and receiving traps. Redesigning these traps enabled scrapers to be dispatched at the exact point of interface.

Operating Techniques

All the remedial measures previously taken had served to decrease the volume degraded by contamination. But nearly one-fourth of each batch was still being reprocessed. Continued experience proved that establishing an operating technique for the handling of batch shipment also could help eliminate contamination. Employe training and indoctrination to give everyone a full background regarding the "why and wherefore" of maintaining a clean stream made it much easier for operators to understand the special instructions concerning the handling of each batch.

A thorough check of the system indicated that manifold valves in the closed position not equipped with telltale nipples were leaking under operating pressure. This allowed crude oil to be mixed with gasoline at two of the pump stations. This cause of contamination was eliminated by installation of fantail blinds at the valve locations in question. Fantails were impractical, so arrangements were made to insure that any leakage would be from gasoline to crude oil by controlling pumping pressures.

To be sure that unavoidable contamination was confined to the interface, all station piping was flushed with gasoline as the forward interface passed each station.

At first, switching of the incoming stream at the terminal from crude-oil storage to contaminated natural storage was determined by the visual color of samples taken at the receiving scraper trap at destination. The switch from the contaminated natural tank into stock storage was made on the basis of Saybold color tests and the A.S.T.M. gum content of samples taken at the same point.

Later, as the size of the interface decreased, it was found that switching of the stream from crude-oil tankage into stock storage could be done at the midpoint of the interface, eliminating the switch into the contaminated natural tanks. The first portion of the interface received was diverted into crude-oil tanks having propeller-type tank mixers. It did not noticeably affect the tank contents.

How Batching Affects Normal Operation

Seal difficulties . . . During the second year after beginning batch shipments of natural gasoline, pump packing was replaced with mechanical-type seals and one main-line station was converted to unattended automatic operation. It was

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soon discovered that unless each station was bypassed during arrival of the forward interface, suspended foreign matter would cause seal failure. This bypass procedure was later incorporated into the scraper schedule to insure against seal failure. Such procedure required manning the automatic station during scraper passage.

Sump tanks . . . At stations equipped with float-control switches on sump tanks, it was necessary to switch to manual operation while pumping gasoline to be sure that the sump wasn't pumped into the gasoline stream.

Control equipment . . . Since all stations used centrifugal pumps, operating pressures while pumping gasoline were less than with crude oil. This required resetting station pressure-control equipment before and after each batch shipment.

Safety and communications . . . Because of the greater hazard of operations while handling gasoline, extra alertness on the part of all personnel was required. Full-period wire communications were essential for coordinating system operations and making checks of hourly pumpings and receipts.

Sampling . . . Line sampling at stations and at the terminal was much more critical during batch movements than when pumping straight crude oil because of the necessity for accurate timing and product grading.

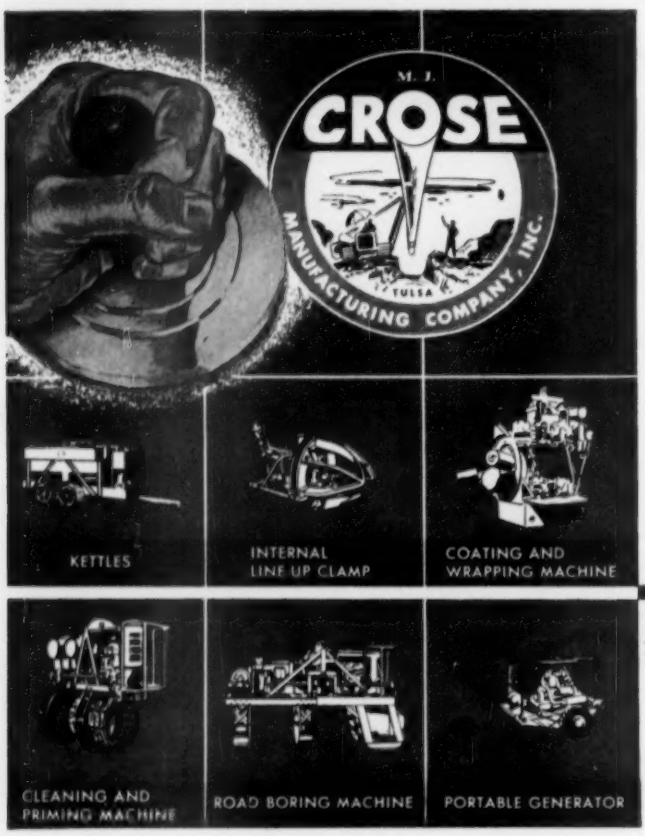
Results of efforts . . . After 3 years of work on methods and techniques, batch shipments were being made in which 95 to 97 per cent of the total volume received was clean and on specifications without further processing.

This not only meant that costly reprocessing had been virtually eliminated, but that terminal tankage formerly set aside for the storage of contaminated natural could be used as working storage for different grades of crude oil.

Conclusion . . . By combining the practimes outlined to achieve minimum contamination and maximum percentage of clean product received, the batching of natural gasoline through crude-oil pipeline systems is technically feasible and offers economical advantages to the shipper. When line capacity is available, it also can be a source of potential revenue for the carrier.

Acknowledgment

To Phillips Pipe Line Co., crude-oil transportation division, Bartlesville, Okla., for its cooperation in supplying the data for this paper.



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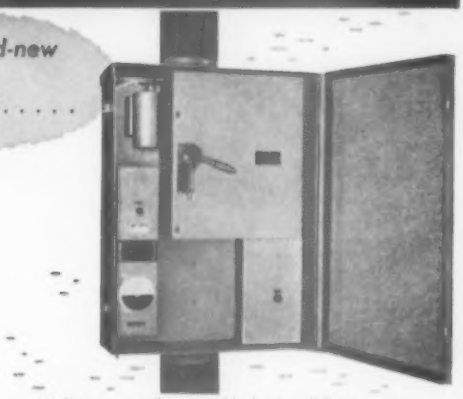

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OF NEW EQUIPMENT AND LITERATURE

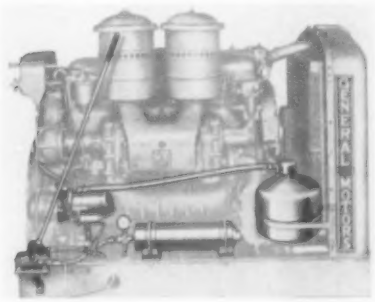
by Dan B. Miller

Hydraulic Starter Operates Under All Conditions

A new hydraulic starting system for diesel engines assures split-second starting even under adverse weather conditions. The unit has been tested in the field for some time and is now available for installation on new Detroit diesel engines at the factory or on others already in operation.

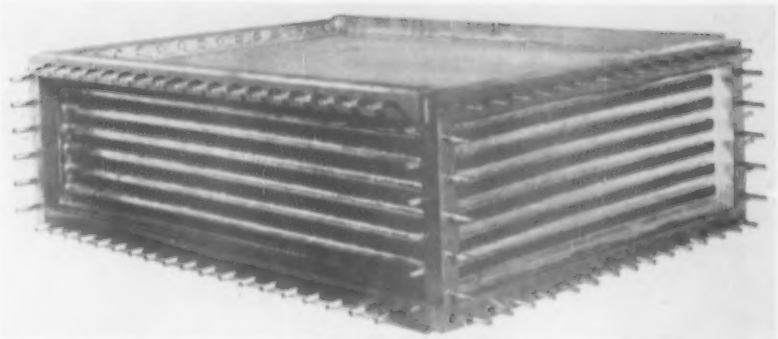
The new system, called the Hydrostarter, eliminates many replacement and maintenance costs common to conventional starters. Its efficiency is not affected by temperature, humidity, or altitude. In zero temperatures, for instance, the unit attains cranking speed almost instantly.

At the press of a lever gas pressure, built up behind a piston in a factory-sealed accumulator cylinder, forces oil



through a hydraulic starting motor. When the engine starts, an engine-driven pump forces the oil back into the cylinder, recompressing the gas and the unit is thus automatically recharged for the next start.

The initial charge is accomplished by means of a hand pump. The unit is then self-sustaining, but the hand pump is available for recharging the cylinder if it should become necessary. This pump can also be used to advantage in rolling the engine slowly to various positions when valve, injector, or other engine adjustments are made. **For more information write or call: Detroit Diesel Engine Division, General Motors Corp., Detroit 28, Mich.**



Heat Exchanger Made for Waste Gases

A new heat exchanger with a finned-plate design has been developed for recovery of heat from high-temperature waste gases. Designated the G-R Plate-Fin exchanger, it is designed to withstand gases at pressures up to 100 psi. and temperatures up to 1,100° F.

Some of the many applications for this exchanger are: a gas-turbine regenerator; recovery of stack gas heat for preheating furnace or kiln air; heating or cooling process gas or plant air; and other gas-to-gas services such as vapor-to-vapor exchangers in petroleum processes.

The Plate-Fin exchanger is of compact crossflow design, with extended surface consisting of corrugations on both the shell and the tube sides. An individual cell of the exchanger consists essentially of three simple parts: the corrugated sheets, the formed and butt-welded flat tubes, and the blanked and extruded sheet-metal tube sheets. All sealing surfaces are heliarc welded to insure tightness, and all surfaces are

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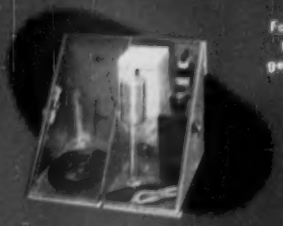
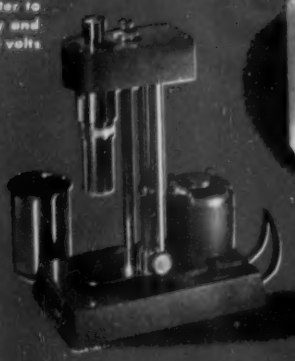
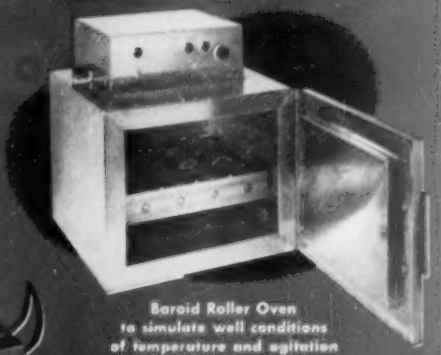


Retort kit to test oil, water and solids content of drilling mud



Fann V-G Meter to test viscosity and gels; 6 or 110 volts



Baroid Roller Oven to simulate well conditions of temperature and agitation

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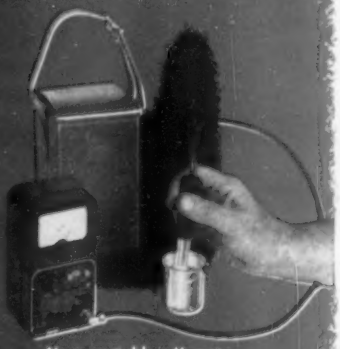

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covered with a protective nickel-base brazing alloy which also joins the corrugated sheets to the tubes. This brazing alloy and its application technique have been developed to resist high-temperature oxidation and corrosion from hot combustion products, sea water, many acids, and other chemicals. **For more information write or call: Griscom-Russell Co., Massillon, Ohio.**

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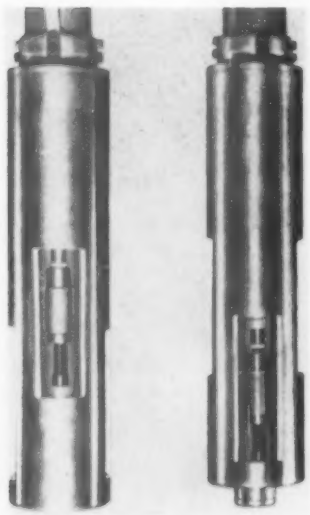

CTI COMPLETION VALVE

Completion Valve Allows Simplified Servicing

A new valve used in well completions eliminates swabbing, allows perforation without hydrostatic head and without pressure on the formation, allows fracturing or acidizing operations through the valve, and can be run with or without water blanket.

Known as the CTI completion valve and adaptable to most types of production packers, it has an aluminum plug at the bottom of the mandrel, held in place by the friction of O-ring packing. This plug prevents the fluid in the well from entering the tubing string until the plug is knocked out.

The valve will not open until the packer is set. As the packer is set, the packer mandrel moves down, forcing the valve mandrels down against the valve shoulder, compressing the springs. This forces the valve mandrels off the test seats and allows the fluid to flow through the valve-body parts, equalizing the pressure below the packer into the tubing string.

With the pressure equalized, the weight of the sinker bar on the perforating line against the plug will knock it out. Should it become necessary to squeeze a well because of high gas-oil ratio or water intrusion, this tool can be run to determine if there is a shut-off. If so, it is possible to perforate through the completion valve for re-completion. **For more information write or call: Completion Tools, Inc., P. O. Box 117, Victoria, Tex.**

Model G Pantograph Handles Pipe Up to 42-In. Diameter

A larger and improved pipe-cutting pantograph, known as the Model G, is designed to handle pipe up to 42-in. o.d. and weighing up to 400 lb. per ft. Straight and beveled cutoffs, miters, and tee intersections on pipe from 8

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to 42 in. in diameter can be cut at infinite surface speeds from 6 to 16 in. per minute.

Standard equipment furnished with the machine enables the user to make cuts requiring up to 20 in. of horizontal torch travel. Optional attachments for obtaining up to the machine's full 40 in. of torch travel are also available.

It is a semiautomatic guided torch machine easily operated by one man. Intersections are cut to exact length on the pipe, thus eliminating the need for many expensive welding fittings. Layouts or templates are not required. All cuts are smoothly finished and beveled . . . no need for grinding, cleaning, or hand fitting. **For more information write or call: Vernon Tool Co., Ltd., 1101 Meridian Avenue, Alhambra, Calif.**

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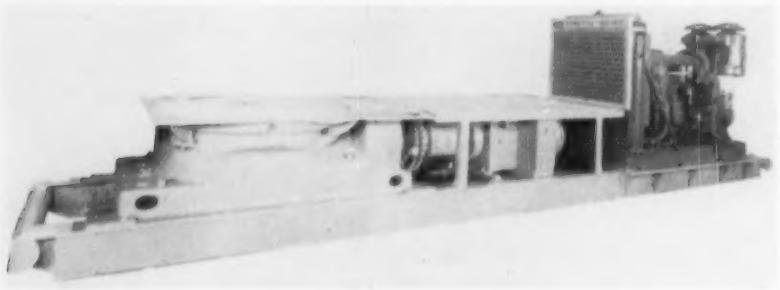

Rotary Drive Has Chain Transmission

The transmission of this rotary-table drive is an oil-bath chain-drive type. It has two forward speeds and a reverse. If the reverse is not needed at the time, it can be converted into a third speed, between the other two speeds. One speed, high, is obtained by an air-tube disk clutch. The other speed and reverse or third speed is engaged by a positive clutch, air operated.

One air-operated brake is standard; a second can be furnished if desired. The engine is mounted slightly off center of the drive-unit skids with the radiator facing the rotary table. Water cooled manifold and muffler can be furnished.

The output shaft of the converter is connected to a shaft at the side of the engine by means of an oil-bath chain drive, and this shaft connects to the transmission through a universal joint shaft.

This unit can be used with any make of torque converter, or with a power-takeoff type fluid coupling, or with a friction clutch power-takeoff, preferably an air-clutch type. It can be used with engines of any speed or horsepower. It is made in two sizes; one for use with engines up to 250 hp. and a larger size for use with engines up to 400 hp. **For more information write or call: Wilson Manufacturing Co., Inc., Wichita Falls, Tex.**

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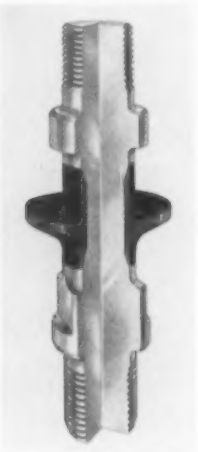

Sand Sentinel Protects Pump During Shutdown

A new sucker-rod sand trap, known as the Sand Sentinel, consists of a heat-treated alloy-steel sucker-rod connector with a Hycar sand trap molded on. It prevents sanding up of oil-well pumps when pumping stops.

Sand Sentinels go in the string of rods. The lip flexes freely to allow the rods to fall freely, or to allow pulling the rods without swabbing the tubing.

When the pump is shut down, the lip of the Sand Sentinel fills the bore of the tubing and catches the sand as it settles out, before it reaches the pump to cause excessive wear and sticking.

When the pump starts, well fluid washes the sand out, and the trap is ready to catch sand the next time the pump stops. **For more information write or call: Petroleum Mechanical Development Co., 3803 South Main Street, Houston 2, Tex.**

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DualDamp Seismometer Weighs Only 11 Oz.

The new dualDamp miniature seismometer weighs less than a pound. The S-39 dualDamp is a velocity-type seismometer especially designed for multiple-array use in land exploration.

The S-39 has been named the dualDamp because it employs both electromagnetic and fluid (Dow Corning Type 200) damping. The seismometer has undetectable spurious response and high lateral stability up to 500 c.p.s., and it has been tested from —60° F. to 150° F. with negligible change in damping. This feature ideally suits the S-39 to high frequency, high resolution operations.

It is 1⅞ in. high, 1½ in. in diameter, and weighs only 11 oz. It has a brass base cap and a stainless-steel case with a solder seal assuring complete protection of the internal element under the most rugged operational conditions.

A special feature minimizing wind noise pickup is the locating of the takeout connection at the bottom. The takeout normally supplied is 18-in., 400-lb. test, wire-rope lay cable with a molded reinforcement. Units may also be ordered with a two-hole cap for through-cable connection. Either spike or flat base attachments may be specified at no change in price.

17-c.p.s. units with 0.55 damping are available for immediate delivery. Other frequencies are available on special order. **For more information write or call: Houston Technical Laboratories, 2424 Branard, Houston 6, Tex.**

•

Timkote Provides Pipeline Protection and Weight

A new asphalt mastic pipeline coating, Timkote, provides a more effective and economical protection for pipelines, particularly those laid under water.

Timkote is a tough, pliable asphalt mastic coating which offers three important advantages over concrete or other conventional pipeline coatings, particularly in offshore work. (1) It is up to 30 per cent more economical to use. (2) It can be handled and laid without cracking. (3) It gives better and longer protection to pipe.

Timkote provides, in one application, both protection against corrosion and the additional weight required for marine pipelines. It is both a corrosive coating and a weight coating, thus affording tremendous savings in time, labor, and materials. With the Timkote process only the bare pipe is handled and transported, since Timkote is applied on the lay barge after the pipe is welded and immediately before it enters the water.

The asphalt mastic produced by the

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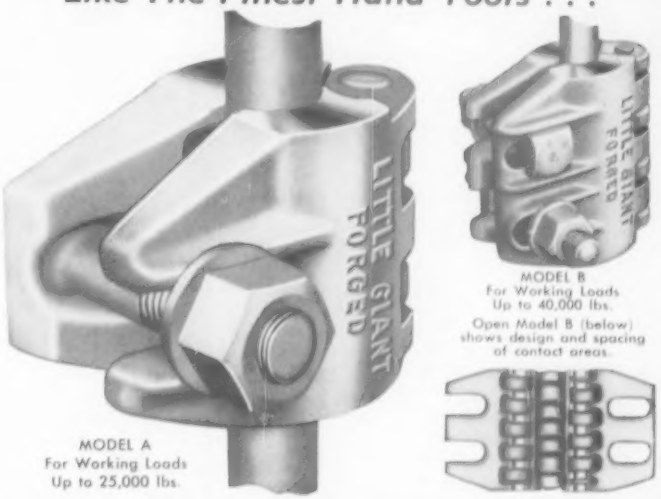
FORGED!

Like The Finest Hand Tools . . .



MODEL A
For Working Loads
Up to 25,000 lbs.

MODEL B
For Working Loads
Up to 40,000 lbs.

Open Model B (below) shows design and spacing of contact areas.

Safe--Strong--Dependable

Forged from high-grade steel—fully heat treated—LITTLE GIANT Clamps maintain high clamping efficiency. Clamping surface is bored smooth to exact polished rod size, assuring even clamping force. Does not mar the polished rod in any way. Superior quality of metal, design and manufacture produces improved clamping effect.

Four styles: Model A, Model B, Model C Special, and Little Giant Jr.; available in all popular sizes from your supply store.

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Timkote process is not only exceptionally tough and pliable, but is also highly resistant to shock and abrasion. It conforms, without cracking, to the deflections of the pipe and thus permits the pipe to be readily handled and laid without damage to the coating. Pipelines coated with Timkote can be laid to any depth without cracking of the coating due to wave action, even under hurricane conditions. **For more information write or call: Southern Production Co., Inc., Fort Worth National Bank Building, Fort Worth, Tex.**

•

Model BKN Provides Better Power to Weight Ratio

The Model BKN four-cycle, single-cylinder, heavy-duty air-cooled engine is rated from 3.2 to 6.8 hp., in a speed range of 1,600 to 3,600 r.p.m.

Entirely new in design, the Model BKN incorporates new engineering features that result in a higher power output per cubic inch of piston displacement. Its 2⅞-in. bore by 2¾-in. stroke provides a displacement of 17.8 cu. in. and delivers top-rated power per cubic inch.

All Wisconsin heavy-duty construction features are incorporated in the new engine. It can be furnished with various gear reductions, clutch assembly, electric starter and generator or starter only. And it can be equipped to operate on kerosine, butane, propane, or natural gas although regularly supplied for operation on gasoline. **For more information write or call: Wisconsin Motor Corp., Milwaukee, Wis.**

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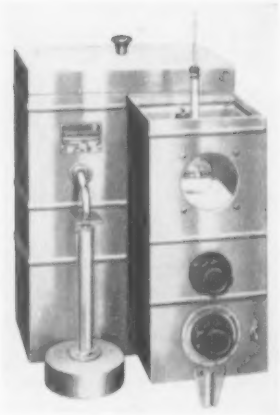
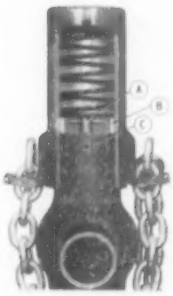
Products Distillation Unit Has Been Redesigned

The front-view distillation units, used in determining the distillation range of gasolines, naphthas, aromatic hydrocarbons, and related petroleum products has been redesigned. Offered



in single, double, and four-unit sizes for ice-refrigerated standard distillations, and for water-cooled gas-oil distillations, the front-view is also available in four and six-unit assemblies with single mechanically-refrigerated condenser troughs.

Heating is provided by the Lo-Cap heater. Because of its low mass, this heater saves time both in initial heating and in cooldown between successive distillations. A variable transformer assures virtually stepless heat, with power input from 0 to 750 watts. **For more information write or call: Precision Scientific Co., 3737 West Cortland Street, Chicago 47, Ill.**



Short Stop Is Safety Unit for Relief Valve

A new safety device for a new shear relief valve is called Short Stop because it is designed and built to be a receptacle that will stop the sheared nail, the stem, and even the bonnet if any or all of them should fly loose.

Short Stop was field tested and perfected by actual use in the deep wells of West Texas and Golden Trend area of Oklahoma.

Its design is heavy and strong in order to render full service when safety is paramount. It also permits rapid replacement of sheared nail. **For more information write or call: New Deal Specialty Co., Inc., Okmulgee, Okla.**

Each Kel-F lined rupture disc is given a leak detector test and must be proven pin-hole free.

The large stock of controlled ductile metals used in the manufacture of BS&B rupture discs enables us to duplicate a previous requirement as well as affording you a wide selection in pressures — from 5 to 50,000 lbs.

For CORROSIVE Conditions

Equip Your SAFETY HEADS With BS&B Kel-F Lined Rupture Discs!

Whenever BS&B Safety Heads are installed in a location where corrosive conditions exist, an unprotected metal rupture disc may be vulnerable to corrosive attack from either the product or the atmospheric side—or both.

The recommended disc to use under these circumstances is the BS&B Kel-F lined rupture disc, which has for more than 3 years proven its resistance to corrosive attack from strong acids, caustics, chlorine, etc. Kel-F is a trade name for a thermo-plastic film of trifluorochlorethylene, which is also known by the trade name of Trithene. Discs may be specified with the Kel-F lining on either or both sides, as your conditions may require.

The use of Kel-F linings in combination with metals of known mechanical and metallurgical qualities such as Inconel, Monel, stainless steel and nickel means positive, trouble-free protection in highly corrosive applications heretofore impossible.

Thus, through "know-how" attained by years of experience in this highly technical field, BS&B has again provided the Process Industries with a *better* safety device for the protection of closed pressure systems!

For full information on the BS&B Kel-F lined rupture disc and its application to your specific problem, consult your BS&B Office or Representative . . . or write to us direct.

THE "CIRCUIT-BREAKER" OF *Any Pressured System*

BS&B Safety Heads

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Safety Head Division, Dept. 2-A11
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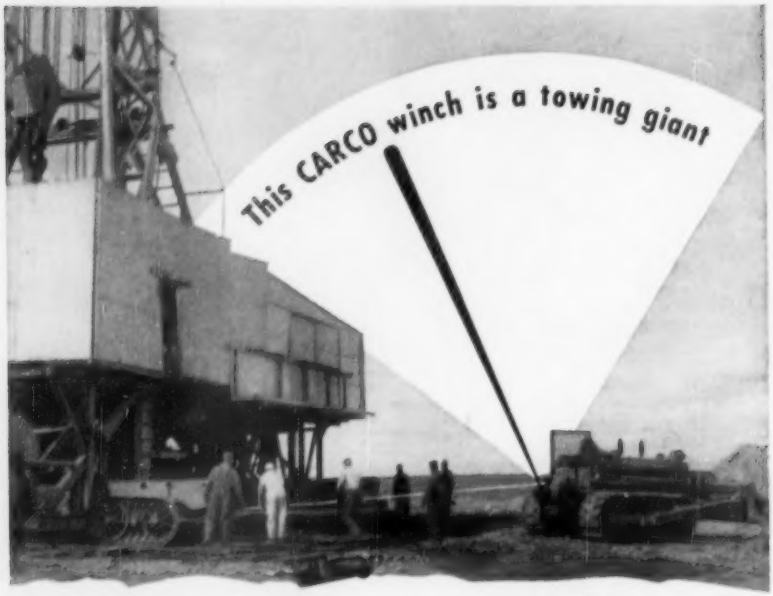
EFFICIENCY OVER 60 YEARS BS&B RELIABILITY



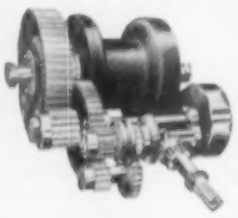
Rigs weighing up to 225 tons moved up to 8 miles

. . . thanks to pulling power of CARCO winch !

Without disassembling, rigs are moved from one location to another in the Tioga oil field in North Dakota. A Model J Carco winch on an International TD 24 is used by the Mendenhall Construction Company to do the pulling. Towing rigs weighing from 150 to 225 tons from two to eight miles is a real test of a winch innards. Hills, mud, sand, snow and frozen ground present problems. If the tractor loses traction, the operator releases winch brake and, paying out line, moves ahead to firm footing. He then winches the rig up to the tractor. The efficient doubling of tractor pulling power does the job.

Mr. Mendenhall states that Carco winches are more compact and better constructed. In over 2000 hours of rough, tough work, maintenance expense has been zero.

You can expect greater value from the leading producer, and get it from Carco, first in winch production. PACIFIC CAR AND FOUNDRY COMPANY, Renton, Washington. Branches at Portland, Ore., and Franklin Park, Ill.



Doubling the pulling power of the most powerful crawler tractors calls for a gear train that's tough and rugged. The Carco Model J winch converts tractor power into line pull efficiently and directly through a 4-stage constant mesh gear train. The doubled line pull is made possible by a high ratio of gear reduction. As faster line speed is generally desired for paying out the line, a lower gear ratio is provided in reverse. Heavy-duty gears and shafts of heat-treated special alloy steel guarantee a large overload capacity. Precision cut, gears and shafts, with anti-friction bearings, operate in a continuous oil bath.

50TH ANNIVERSARY 1900 1950 PACIFIC CAR AND FOUNDRY COMPANY

WINCHES
FOR ALL INDUSTRIAL TRACTORS

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Get Inside Information With Elgen Logs. Electrical well-logging Bulletin A-55 discusses the S.P., resistivity, short normal, long normal, and lateral curves, as well as depth measurement and permalogging. Also included are comparative reproductions of an electronic log and permalog. **For more information write or call: Elgen Corp., 179 Parkhouse Street, Dallas 7, Tex.**

Oil-Well Pump Bulletin. A two-page bulletin describes the operation of the new VoluMax (maximum capacity) working barrel, now in production. The VoluMax is recommended where the presence of water necessitates a larger volume pump. Production is increased at the same plunger travel, or the same volume of production may be maintained at slower cycle rates. **For more information write or call: Axelson Manufacturing Co., Division of U. S. Industries, Inc., P. O. Box 58335, Vernon Station, Los Angeles 58, Calif.**

Tight-Closing Rate-of-Flow Controller. A power actuated rate-of-flow controller of advanced design for the effective operation of water, waste, or industrial plants is described in a four-page color bulletin. Bulletin 600-J9A contains descriptive information on the operation and installation in addition to photos, flow diagrams, and tables. One of the two models described, the RCB-T, comes equipped with a rubber-seated butterfly valve for tight closure. **For more information write or call: Builders-Providence, Inc., 345 Harris Avenue, Providence, R. I.**

Kel-Ray Projectors. A portable gamma-ray projector with decided advantages of economy and operation in industrial radiography is the subject of a new 24-page booklet. As described in the booklet, the new projector offers a high degree of penetration yet is safe to operate, costs only a fraction as much as comparable X-ray equipment, is portable, and needs no electricity, control board or maintenance beyond replenishment of the radioisotope. The booklet introduces its subject with a discussion of radioactive materials, isotopes, kinds of radiation, and hard and soft rays.

For more information write or call: Metal & Thermit Corp., 100 East 42nd Street, New York 17, N. Y.

Diesel and Gas Engine Lubricating and Fuel Oil Maintenance. Oil contaminants are divided into two groups in this new analysis, Bulletin 172, with recommendations for lubricating oil filters, either bypass or full flow. A tabulated chart based on engine horsepower lists the proper type and size of required oil-filtering equipment needed. **For more information write or call: Hilliard Corp., Oil Purifier Division, 102 West Fourth Street, Elmira, N. Y.**

Eleven Ways to Avoid Boiler Tube Corrosion is the title of a recent publication. This eight-page folder, TR-537, contains important data resulting from an extensive study of the company's metallurgical staff. Many of the causes of corrosion in boiler tubes are explained in detail along with suggested methods of eliminating these same causes. **For more information write or call: Tubular Products Division, Babcock & Wilcox Co., Beaver Falls, Pa.**

SR-4 Fluid Pressure Cells and their uses in electrical measurement and control of pressure are presented in a new 16-page Bulletin 4306. Six standard types of cells in 25 sizes ranging from 15 to 50,000 psi., as well as some special-purpose cells, are included. Characteristics, principles of operation, instrumentation, and specifications are given. **For more information write or call: Baldwin - Lima - Hamilton Corp., Philadelphia 42, Pa.**

Storage Tank Venting Fundamentals. Principles of venting flammable-liquid storage and process tanks for effective operation, fire protection, and low-cost maintenance are completely described in a new booklet illustrated with photographs and diagrammatic drawings explaining the text. Numbered references in the descriptive sections refer to the same numbers on the illustrations, and the application of each principle is explained clearly and concisely. **For more information write or call: Protectoseal Co., 1920 South Western Avenue, Chicago 8, Ill.**

A Tape-Coating Data File provides complete information on Plicoflex polyvinyl-chloride-tape coatings for pipeline corrosion protection. This file contains technical data and price lists for both No. 330 polyvinyl chloride single-film-tape coatings and No. 340 polyvinyl chloride laminated-tape coatings. Technical data include general properties of tape coatings, approximate pipe-coverage requirements and application instructions. Price lists cover black and

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Skid base mounted Viking heavy-duty pumps are the work horses of many oil field pumping jobs. The field installation view above is a good example. For positive pipeline gathering service, use these engine-driven units. Install wherever they are needed. No protection required. Complete range of capacities available . . . 35, 50, 90 GPM and up. For the complete line of Viking heavy-duty pumps, send for Catalog Ct today.

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FIGURE 400 CHOKE UNIONS provide a low cost means of reducing line volume or pressure. Insert orifice plates (that may be changed by backing off the wing nut) are available with orifice sizes from ⅛" through 1", giving a wide selection through which to regulate downstream flow. Where only temporary regulation is required, full opening orifice plates can be supplied.

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Texas Continental Tube has stocks located throughout the oil country — near you. For outstanding service, contact . . .

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Are EFFICIENT –
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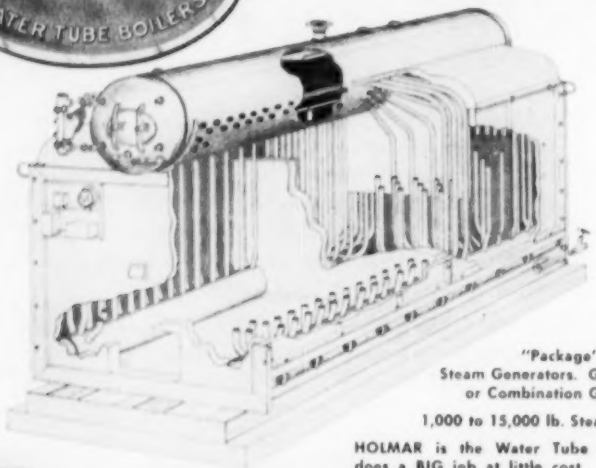

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Plant: 3207 Dawson Road

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colored tape coatings and adhesive primers and give packaging data. **For more information write or call: Plicoflex, Inc., 1566 East Slauson Avenue, Los Angeles 11, Calif.**

Full-Opening LR and KVR Packers. In addition to illustrations and complete operating information this four-page bulletin includes price lists, engineering data, and surface-setting information on 5½ by 2½-in. packers. **For more information write or call: Guiberson Corp., 1000 Forest Avenue, Dallas, Tex.**

Data and Price List. This revised catalog section covers rock bit types, three-cone rock bits, two-cone rock bits, small blade bits, drill pipe, tool joints, subs, tubing and tubing-tool joints, and drag bits. **For more information write or call: Varel Manufacturing Co., 9230 Denton Drive, Dallas, Tex.**

Aluminum Pipe and Fittings. Aluminum pipe for conveying everything from air to acid is thoroughly described in a new 18-page booklet. The booklet presents the product's characteristics and advantages for each of its major fields of application. Specifications are provided, along with a description of appropriate fittings and methods of installation. After a brief introduction, the new two-color book describes process-industry applications of aluminum pipe and its advantages for that type of service. **For more information write or call: Aluminum Co. of America, 770 Alcoa Building, Pittsburgh 19, Pa.**

New PB Pigtail Sucker Rod Wiper Rubber. Bulletin BJO-691 describes the free-winding action which adjusts wiper automatically to any rod size including tapered strings and macaroni tubing. Action gives longer rubber life because stretching and flexing of wiping orifice is minimized. Flanged adapter ring enables wiper rubber to be used in existing housings. The bulletin also gives information on PB standard and paraffin sucker-rod wiper assemblies. **For more information write or call: Byron Jackson Division, P. O. Box 2493, Terminal Annex, Los Angeles 54, Calif.**

Bronze Rotocycle Meters. A new eight-page bulletin, OG 409, describes an entire new line of all-bronze Rotocycle meters. Meters described include 2, 3, and 4-in. bulk-type models and 2 and 3-in. tank truck models. Flow rates range from 20 to 500 g.p.m. Also described is a complete line of accessories including remote-registration systems for one-man metering control, a variety of reading registers, strainers, air eliminators, register extensions, temperature compensators, impulse contactors,

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THE WORLD'S LARGEST INDEPENDENT OILFIELD SUPPLY AND SERVICE ORGANIZATION

swivel adapters, and angle adapters. **For more information write or call: Meter & Valve Division, Rockwell Manufacturing Co., 400 North Lexington Avenue, Pittsburgh 8, Pa.**

Sling Handbook. Several new developments in Tuffy slings have necessitated a new and expanded edition of the Sling Handbook. Foremost of new developments is a streamlined, heavy walled, steel-ferrule eye splice. It is slipped on over a tuck splice of the machine-braided fabric and then pressed on under such tremendous pressure that the metal of the ferrule virtually flows into the interstices of the fabric. Advantages which users mention are: (1) the safety of a splice fortified against pullout; (2) the safety and speed of loading and unloading due to the fact the streamlined design and swaged-in ends of the ferrule leave no abrupt projections to catch on hands or loads. **For more information write or call: Union Wire Rope Corp., 2100 Manchester Avenue, Kansas City, Mo.**

Metal Surface Treatments Manual. This manual was written to aid in selecting metal surface treatments for metal parts to resist wear, heat, and corrosion. As used in maintenance manufacture, the goal is to improve the service life of parts in difficult service. Sections of the manual include: repair-replace service; specifications; metal charts; and outstanding applications. **For more information write or call: Texas Alloy Products Co., Inc., P. O. Box 19067, Houston, Tex.**

Selective Collet-Type Casing Packer and Landing Nipple features an annotated illustration of equipment and lists most of the advantages. Critical dimensions are tabulated according to size, and operating information is included. **For more information write or call: Otis Pressure Control, Inc., 6612 Denton Drive, Dallas, Tex.**

Analytical and Control Instruments is a general catalog covering an analytical mass spectrometer, leak detector, isotope-ratio mass spectrometer, dual-purpose mass spectrometer, micromanometer, process-monitor mass spectrometer, titrilog, spectrosadic, and analytical service. Bulletin CEC 1302B is well illustrated and is perforated for binding. **For more information write or call: Consolidated Electrodynamics Corp., 300 North Sierra Madre Villa, Pasadena 15, Calif.**

V-5 Pressure and Temperature Gages. A 12-page Bulletin 806 describes a new line of small-size receivers and draft, pressure, and temperature gages. The new gages give excellent readability and accuracy with a scale measuring only 5 in. high. Each V-5 gage is an individual, self-contained measuring unit which may be mounted separately or grouped together with as many as eight units in a single case. All standard draft ranges, pressures up to 100 psi., and temperature to 1,000° F., may be measured directly with V-5 gages. Bellows models may be used to receive standard output pressures from pneumatic transmitters and controllers. **For more information write or call: Republic Flow Meters Co., 2240 Diversey Parkway, Chicago 47, Ill.**

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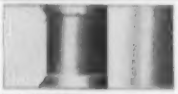
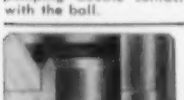


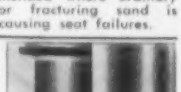
"Single Seal" Seat
A competitively priced stainless steel seat for routine pumping.

"Double Seal" Seat
For harder than usual pumping—double contact with the ball.



"O-Ring" Seat
A 2-piece stainless steel seat specially recommended where ordinary or fracturing sand is causing seat failures.

"Sheralloy" Seat
A cast alloy definitely proved resistant to corrosion. Also good for hard pumping.



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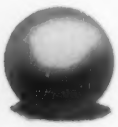
AT YOUR FAVORITE SUPPLY STORE

"Sheralloy" Ball
Excellent to combat corrosion and hard enough for deep pumping. Non-magnetic.



"Ceramic" Ball
Nearly as hard as a diamond. Non-corrosive and non-magnetic.

"Stainless Steel Ball"
For ordinary pumping where little trouble is encountered.

EQUIPMENT MEN . . . in the News

Lane-Wells Opens Office, Shifts Sales Personnel

According to an announcement from Lane-Wells Co., expanding activity in the Williston Basin has prompted the establishment of a new truck station at Watford City, N. D. Elmer R. Thompson has been named operator in charge.

J. Shannon Baker, operating from Lane-Wells head office in Los Angeles, moves into the position of assistant chief geophysical engineer.

Stepping into Baker's previous position is Paul O'Haver, who becomes acting division engineer, Pacific Coast division.

R. G. Hicks, formerly a division field engineer in Gulf Coast division, is now in Lane-Wells Houston office, acting as district operating engineer.

Russell A. Nelson has moved from Oklahoma City, where he was a division engineer, and is now district operating engineer at the Lane-Wells branch in Casper, Wyo.

Vern D. Hilterbran moves from his job as radioactivity well-logging operator to the station superintendent's spot at Lane-Wells Farmington, N. M., branch.

Western Co. Opens Dallas Research Facility

The opening of a new research facility at Dallas by Western Co. has been announced by John F. Younger, vice

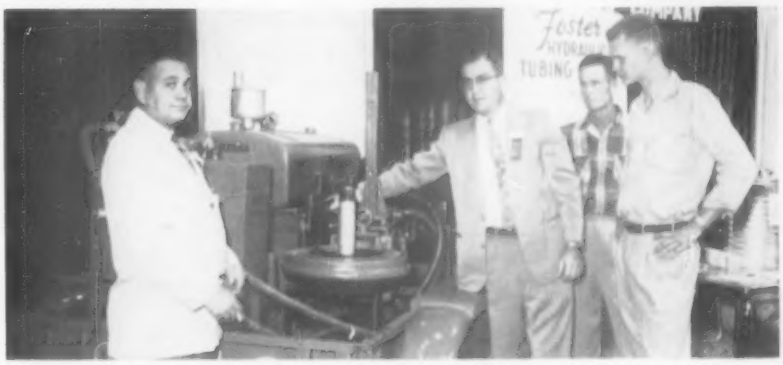
W. E. BROWN

B. JACKNIN

president of the research and development division of the Midland, Tex., firm.

The new facility will be staffed by research associates and their assistants who will conduct research activities in all areas of well servicing, including radioactivity logging, perforating, fracturing, and acidizing. The research associates who are opening the new facility are William E. Brown and Bernard Jacknin.

Dallas was selected as the site for the new department because of the availability of research facilities and its nearness to the production areas of the Southwest.



Foster Cathead Exhibits at Gulf Coast Show

At the recent Gulf Coast Oil Exposition in Lafayette, La., Foster Cathead Co. displayed its new tubing power tongs. Glenn Tedford, sales manager and partner of Foster Cathead, is shown displaying the operation of the tongs. Also representing Foster Cathead at the exhibition were Jerry McCrary, Corpus Christi representative; Marvin Peck, Houston representative; and R. D. (Dobbin) Cloninger, Lafayette distributor and president of the oil exposition.

Union Steam Pump Names de Keyser District Manager

Douglas E. de Keyser has been appointed district manager of the Philadelphia office of Union Steam Pump Co. Under him the sales and service facilities of Union will be expanded in the Philadelphia market.

De Keyser joined the home-office sales staff at Union after many years of pump experience and served there in a technical and planning capacity prior to his present appointment to Philadelphia.

Oilwell Shifts Thrasher To El Dorado District

The transfer of Albert O. Thrasher, district representative for U. S. Steel's Oil Well Supply Division, from Seminole, Okla., to El Dorado, Kans., has been announced by Mark Barkhurst, Mid-Continent area manager of the division.

Thrasher joined Oilwell as a field representative at Seminole in 1949. He was appointed store manager there in 1951 and district representative at that location in 1953.

Cardinal Announces Appointment of Caffrey

Cardinal Chemical Co., Inc., Dallas, announces appointment of James C. Caffrey, Midland, Tex., to do sales contact.

Formerly associated with Western Co., Caffrey has been in the industry 15 years, having served as automotive superintendent and district and station manager for Western.

Caffrey will work out of Midland.

Consolidated Engineering Approves Applicable Name

The board of directors of Consolidated Engineering Corp. approved a change of the company's name to Consolidated Electrodynamics Corp. The new name will be submitted for stockholder approval at a special stockholder meeting.

Philip S. Fogg, president and board chairman of the Pasadena instrument firm, explained that the company's present name "does not adequately describe the broad scope of business in which the company is engaged."

Fogg also noted that Consolidated Engineering has been unable to qualify to do business in two key states under its present name. "In New York," Fogg said, "a state law prohibits a company of our type from doing business if it uses 'engineering' in its name. In Pennsylvania, qualification has been denied because of the existence of a company bearing a similar name. This situation made it necessary to set up

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New Mill Offers You These Protection Advantages at PROVO, UTAH

This modern PLS Plant No. 8 at Provo, Utah, is located on 29 acres and is served by the Union Pacific and Denver & Rio Grande Western railroads. Features PLS-designed equipment for controlled, *under-roof* oven-drying, shot cleaning, priming, coating and wrapping.

- ★ In-transit privilege permits storage and processing service at through freight rates from west coast, south central and eastern pipe mills to destinations beyond Provo.
- ★ Ample storage space to store large quantities of pipe at no extra cost. Your pipe is always available when you need it.
- ★ Finest steel pipe protection assured by mill-applied methods. Under-roof service—no weather delays. Modern equipment operated by experienced personnel guarantees uniform quality.

PLS

Dependable Service since 1931

PIPE LINE SERVICE CORPORATION

Pioneers in Steel Pipe Protection

General Offices and Plant: — Franklin Park, Illinois

Plants also at Glenwillard, Penna.; Greggton (Longview), Texas; Corpus Christi, Texas; Harvey, La.; Sparrows Point, Md.; Monmouth Junction, N. J.; and Provo, Utah.

a separate corporation, CEC Instruments, Inc., to carry on sales and service activities in these states.

W. K. Luby Joins Sil Flo As General Manager

W. K. LUBY

William K. Luby has joined Sil Flo Corp. of Fort Worth, Tex., as vice president and general manager, W. T. Snipes, president of the company, has announced.

Luby was formerly with Corn Products Refining Co. where he was process technical director of manufacturing. His experience over the past 18 years covers engineering, production, chemical and quality control, technical service, administrative management.

In addition to direction of manufacturing operations at Sil Flo, Luby will direct the technical service department, quality control and research.

Southwestern to Merge With Dresser Industries

Southwestern Industrial Electronics Co. of Houston, manufacturer of electronic equipment having particular application in the petroleum industry, has completed negotiations for a merger with Dresser Industries, Inc., according to an announcement by Keith R. Beeman, president of SIE. Completion of the merger must be confirmed by the board of directors of both firms.

SIE was organized in 1945 as a partnership between Beeman and Richard H. Parker, now executive vice president of the firm, to build transformers and electronic instruments for the geophysical industry. SIE's geophysical equipment is being used in nearly every oil-producing area of the world. The company also manufactures auxiliary equipment, such as truck instrument bodies and all the related devices required to outfit a seismograph field party.

H. M. Mallon, president of Dresser Industries, Inc. stated: "In a very real sense, the merger with SIE represents the continuation of a program begun by Dresser earlier in the year with the acquisition of Lane-Wells Co., supplier of radioactivity well logging and gun and jet perforating services for oil and gas well drilling. The extensive research facilities of these two companies will undoubtedly produce complimentary benefits, and they form the basis for a growing participation for Dresser Industries in the rapidly ex-

AN ENGINEER LOOKS AT W-K-M VALVES

ON DESIGN

Leverlock operation of the expanding gate in W-K-M Pipeline Valves, 6" and larger, is positive assurance of free and easy opening or closing regardless of service conditions. It is but one of the multiple advantages that make W-K-M Valves unequaled in performance on pipelines throughout the world.

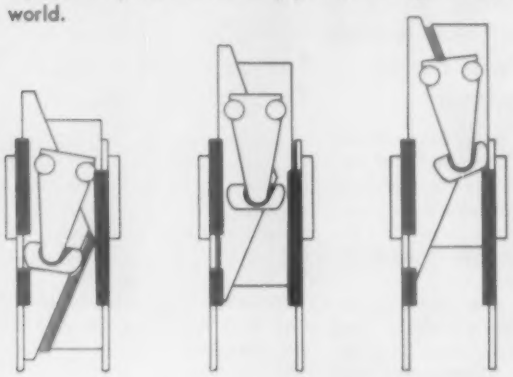

Fig. 1 Fig. 2 Fig. 3

HERE'S HOW LEVERLOCK ASSURES POSITIVE, EASY OPERATION

The Leverlock holds the gate and segment in a neutral position while valve is being opened or closed — and permits expansion of the gate assembly for seating in opened or closed position.

Fig. 1 shows gate and segment in closed position. As the valve opens, the Leverlock arm swings to the right and travels between guides (Fig. 2) on the seat skirt. Since the arm cannot swing to the right or left, the gate and segment are held in a neutral position. When gate and segment reach open position, the Leverlock arm swings into a slot in the seat skirt (Fig. 3), permitting the gate and segment to expand against the seats.

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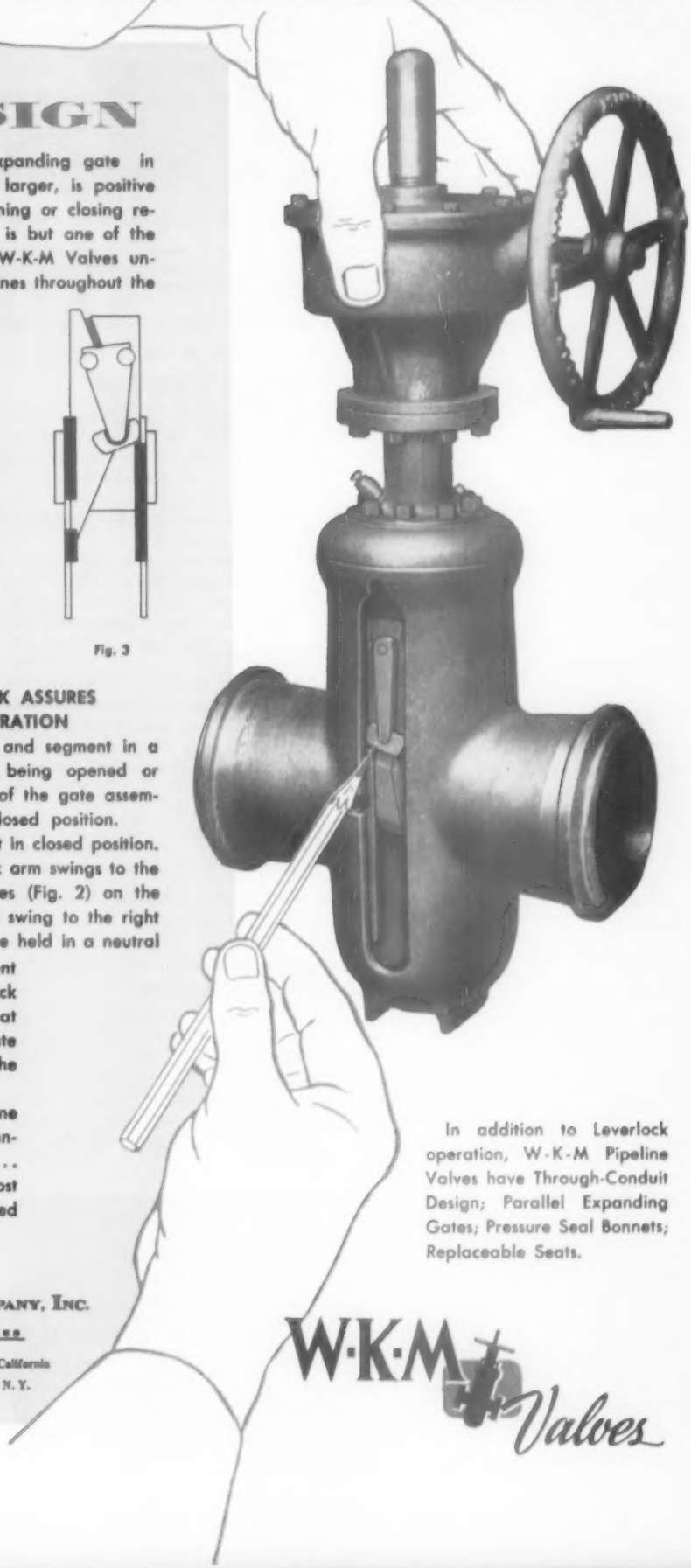

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panding field of electronics and instrumentation within the oil and gas industries and within general industry."

G. V. Holton Made Director Of Perkin-Elmer Corp.

G. V. HOLTON

George V. Holton, formerly chairman of the board of Socony Mobile Oil Co., Inc., has been elected a director of Perkin-Elmer Corp., according to Richard S. Perkin, president and chairman of the board of the Norwalk, Conn., firm.

Holton, after practicing law in Rochester, N. Y., became associated with the general counsel of Vacuum Oil Co. In 1923 he moved to New York as assistant counsel for the company, became its secretary in 1925, general counsel in 1930, and a director in 1931.

When Vacuum Oil Co. merged with Standard Oil Co. of New York in 1931, Holton became associate general counsel of Socony-Vacuum Oil Co., now Socony Mobile Oil Co., Inc. In 1932 he became general counsel and was elected a member of its board. He served as a vice president from 1938 to 1948, when he was named chairman of the board. He held this position until his retirement in July 1955.

Waukesha Sales Opens New Abilene Branch

Waukesha Sales & Service, Inc., Houston, has opened this new branch in Abilene, Tex., to serve users of Waukesha engines in that area. The branch carries a complete line of Waukesha engines and replacement parts and operates a 24-hour-a-day repair service. Cecil Hobdy is manager.

Texas Bank & Trust Names Nichols as Consultant

The oil department of Texas Bank & Trust Co. of Dallas has been enlarged to include the services of Earl A. Nichols as oil consultant, according to a joint announcement by W. W. Overton, Jr., board chairman, and P. B. (Jack) Garrett, president.

Prior to entering the private consultation field in 1947, Nichols was manager of the reservoir-fluid analysis department of Core Laboratories and served also as technical advisor to the president.

Nichols' oil financing activities with the bank will include evaluation, reservoir studies, and related oil matters. He will work with independent oil men as well as with banks doing business with oil men.

Norman Joins Axelson As Texas Representative

Appointment of William H. Norman as factory representative for the Overton and Kilgore, Tex., area has been announced by Ken S. Ramey, petroleum-equipment sales manager of Axelson Manufacturing Co., division of U. S. Industries, Inc.

Norman was formerly with Sperry-Sun Well Surveying Co. and Baroid in the Texas oil fields.

Sheen Elected President Of Instrument Society

R. T. SHEEN

Robert T. Sheen, president of Milton Roy Co., Philadelphia, was elected president of the Instrument Society of America at its tenth annual Instrument-Automation Conference and Exhibit recently held in Los Angeles. Two vice presidents and secretary elected were: Richard N. Pond of Taylor Instrument Co., Rochester, N. Y., as vice president in charge of the society's technical division committees; J. Ward Percy of U. S. Steel Corp., Kearny, N. J., vice president in charge of recommended practices division consisting of 23 subcommittees; and Dr. William G. Brombacher of Chevy Chase, Md., secretary.

The four hold-over officers serving second year terms are: William H. Fortney, Humble Oil Co., Houston, first vice president; A. A. Anderson, Swissomatic Products Co., Santa Monica, Calif., vice president; and J. T. Vollbrecht, Energy Control Corp., New York, treasurer.

The ISA, organized in 1946 and now with more than 8,000 members, is the only national group devoted exclusively to the theory, design, manufacture, and use of all types of instrumentation and automation control for industrial, commercial, educational, research, and consulting organizations.

Chiksan Conducts Annual Sales Conference

Chiksan Co. recently concluded its second general sales conference at the main plant and home office at Brea, Calif. Attending the 3-day session were over 70 salesmen and representatives. Included were the sales force of Well Equipment Manufacturing Corp. of Houston, a Chiksan division, and sales personnel from Chiksan Export Co., Brea, and Chiksan of Canada, Ltd., Edmonton, Alta, Chiksan subsidiaries.

H. J. Hagn, Chiksan president explained the stock transfer which resulted in Chiksan's becoming a wholly owned subsidiary of Food Machinery & Chemical Corp.

G. R. Winder, vice president and general sales manager of Chiksan, presided over subsequent sessions during which new products were introduced.

The conference was devoted largely to presentations by Chiksan's engineering department under G. M. Bagnard, chief engineer, and K. J. Downs, chief design engineer, who told of current projects, many of which will result in future Chiksan products.

Chiksan and Weco sales representatives at the general sales conference.

Fahey Flynn asks:

WHAT DO YOU LIKE BEST ABOUT YOUR JOB?

FAHEY FLYNN, well-known radio and television newscaster, WBBM, WBBM-TV, CBS, Chicago

ROBERT P. MATTHAIDESS, Assistant Department Supervisor-General Accounts, Standard Oil, Omaha, Nebraska:

"It's the 'open door' to advancement that I like best about my job. I started with Standard Oil in 1947, and since then I have moved from a warehouse to the Division office and through four departments, gaining invaluable experience in each job. There have been helpful training courses right along for the next step up. Anyone who applies himself can certainly keep going ahead in a large, well-organized company like this. Yes, it's the 'open door' to progress that I like best."

SELMA ERICKSON, Assistant Personnel Supervisor and Women's Counsellor, Standard Oil General Office, Chicago:

"It is the privilege of helping people make the most of their opportunities that I like best about my job. In my job I share the responsibility of personnel work in an office where more than 1,600 people are employed. It is our job to apply the company's personnel policies in such a way that our people can work happily and effectively to help themselves, each other, and the company. That's why I like best the privilege of helping people make the most of their opportunities."

ELDON L. JOHNSON, Standard Oil Dealer, Rochester, Minnesota:

"Ever since I was a kid I wanted to manage my own business, and that's what I do here—lock, stock and barrel. In any kind of service business, you can build a sizable volume if you provide fast, efficient service and quality products. And that's the kind of station mine is. The result is comfort, happiness and security for my family. How can you beat that?"

WILLIAM R. SHIMMIN, Group Leader, Automotive Research Division, Standard Oil, Whiting, Indiana:

"Automobiles of the future will require new, higher-octane gasolines and specially-tailored motor oils. While those cars are still on the drafting boards, the fuels and lubricants must be developed in research laboratories so they'll be ready at the same time. At Standard Oil we have a continuing program to develop products for the automobiles the public will be driving in coming years. As part of the Standard Oil team that prepares products for the future, I am among the first to see the engines of tomorrow perform with the fuels and lubricants of tomorrow. It's a wonderful experience."

When a man likes his job he does a good job. The greatest strength of Standard Oil Company is the loyal enthusiasm of its employees and dealers. Their skills and abilities make it possible for us to give good service and bring the finest possible petroleum products to motorists, home owners, farmers and industrial customers throughout the Midwest. The company takes pride in the job they are doing. It gives meaning to our pledge—"You Expect More From Standard—And Get It!"

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Why have the pyramids lasted so long? The same engineering principle that made them last for ages makes ***Mission Piston Rods*** wear on and on. More than 6600 years ago when the Egyptian engineers built the pyramids they chose the hardest stone available for the body of the pyramids. Then to resist the abrasive sand storms, the rain, and the ravages of time, they faced them with a layer of smooth, polished stone. They fitted the polished stones together to make an even hard surface that would resist the cutting action of the blowing sand. How well they succeeded is proved by the pyramids themselves — 6600 years later.

Just as the Egyptian engineers chose the hardest material available for the body of the pyramids, **Mission** engineers have developed the "File Hard" rod with a core tensile strength of 120,000 psi. Then, just as the Egyptians, **Mission** engineers put a smooth, hard surface on the rods to resist wear and corrosion. **Mission "Satin Finish"* Rods** have an ultra-smooth finish over the entire rod. Then to defy the most corrosive conditions **Mission** developed the **"Super-Chrome" Rod** with a corrosion proof, wear resistant chrome coating. This rod actually has two lives. After long, corrosive and abrasive use has worn away the chrome, the **Satin Finish* "File Hard" Rod** remains to give another period of long wear.

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on the well above:

(1) 7" OD casing cemented at 13,808', using 500 sacks neat Unaflo Cement. Mud weight: 18 lbs. per gal. BHT: 291°F. at 13,000'.

(2) Drilled to 16,120'; plugged back through retainer set at 13,100'. 140 sacks neat Unaflo squeezed below tool and 60 reversed back out.

(3) 250 sacks neat Unaflo pumped into place behind 5" OD casing string bottomed at 13,119'. Mud weight: 17.4 lbs. per gal. BHT: 291°F.

*"UNAFLO" is the registered trade-mark of the retarded oil-well cement manufactured by Universal Atlas Cement Company

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EXPLORATION

Golden Gate Opens On a New Oil Play

by Frank J. Gardner

CALIFORNIA has a new oil strike near San Francisco that should not go unnoticed. It is distinctive on several counts. Despite modest initial pump gages, the discovery well revives production in an almost-abandoned oil province and points up the possibilities of a region never exhaustively explored.

Here is one of the oldest oil areas in the United States, a fact that is half forgotten by most of us. An oil boom began in the San Francisco Bay area in 1865. Rapidly growing San Francisco was in dire need of a source of cheap fuel. Gas was being made from coal, which cost $40 a ton, and the gas itself sold for $15 per M.c.f. Manufactured illuminating oils supplied the city with light.

Moderate success . . . But seepages of oil in Santa Clara and San Mateo counties, and asphaltic and bituminous seepages in Marin, Contra Costa, and Santa Cruz counties held promise of new power sources. A rising need and a hungry market nourished an active search for oil, both by drilling and by sinking shafts and tunnels near seepages. Success was moderate, but success it was, and it was oil from Halfmoon Bay on the west coast of the San Francisco peninsula that lit the legitimate theaters, the burlesque shows, and the saloons of old San Francisco in the 1880's.

Sargent field, in southern Santa Clara County, has produced 780,000 bbl. of oil to mark it as the largest field ever found in the bay area. It, too, was found near large oil seepages in the vicinity of the field. The first wells were dug in 1886 and commercial production began in 1904.

At Moody Gulch, small wells were completed for 10 to 40 bbl. per day in the early 1880's, and at least one well continues even now to produce about a barrel of high-gravity (40°) oil each day. Up until last week, these were the dying stages of an oil boom that began nearly 100 years ago.

A new California discovery in San Mateo County is expected to revive exploratory activity throughout the San Francisco Bay counties. Halfmoon Bay and Sargent fields were discovered decades ago, but current production in the entire region is nil.

In a new play . . . Now, the bay area may be in for a new play. In the Boulder Creek area of southeastern San Mateo County (see map), Union Oil Co. of California and Richfield Oil Corp. are putting pump on their I Costa, a new discovery in the rugged terrain of the Santa Cruz Mountains. Production is coming from the Butano-Oligocene sand at 2,060-2,160 ft. at daily rates averaging 70 bbl. of 41°-gravity oil. Total depth of the well, located in Section 14-8s-3w, was 3,804 ft., plugged back to 2,206 ft.

Operators have had considerable difficulty with the completion because of sanding troubles; earlier estimates of potential capacity ran as high as 150 to 200 bbl. daily. The usual leasing activity followed these early reports, and the rank wildcat was hailed as possibly the most important California find of the year. Later developments tend to disprove this, but at least the discovery will attract wide attention.

The new field lies at the southeastern end of a Pliocene embayment that extends northwesterly to the vicinity of Halfmoon Bay. At the south, the embayment is bifurcated, one arm extending nearly due south to southwestern San Mateo County, and the other southeast to the Boulder Creek area. Production in the Halfmoon region was from Purisima-Pliocene sands, a sedimentary series exceeding 9,500 ft. in thickness throughout the deeper reaches of the embayment. The old fields were localized by folds and faults along a northwest-southeast trend extending from Halfmoon Bay to La Honda.

Seepages from Miocene and Pliocene sands led to the original nineteenth-century plays, and it is not unlikely that a reasonable amount of success at Boulder Creek will lead to considerable new activity and reexamination of these old areas in a search for shallow production. Altogether, a 26,000-ft. section of Cretaceous, Eocene, Oligocene, Miocene, and Pliocene strata await exploration by the drill in the embayment. But the extreme complexity of subsurface folding and faulting will challenge the best geological interpretation before any great success is achieved.

May mean new fields . . . But the one important thing about this bay region is its promise of future oil fields. It has been proved that source rocks, reservoir rocks, and suitable traps exist, and that oil is actually present. The finding of commercial pools is the final responsibility of the subsurface geologist, and the Golden Gate area is just one among many of his ringing challenges in California.

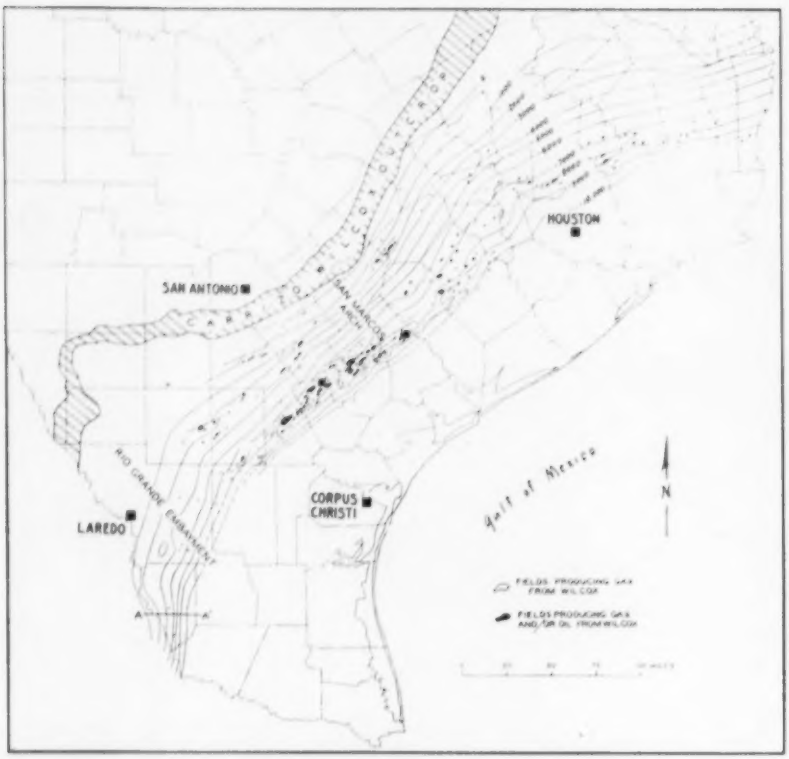

FIG. 1—The regional Wilcox structure of coastal Texas, contoured on top of the Carrizo-Wilcox. Contour interval: 1,000 ft.

The Geologic Framework Of the Wilcox Reservoir

by Lloyd J. Ryman
Continental Oil Co.

The author says, "Here is the bare framework of the geologic architecture of an important producing trend. It is intended to provide a background of basic knowledge for those who are seeking to increase the eventual recovery of oil from this formation."

THE Wilcox producing area of Texas consists of a band 40-60 miles wide extending from the Rio Grande to the Sabine River, and paralleling the Gulf Coast some 40-150 miles inland.

The first Wilcox production in Texas was established in 1928 at Clay Creek field in Washington County, but active development did not get under way until 1937. The shallowest production from this formation is at approximately 450 ft. and the deepest below 11,000 ft.

Stratigraphy and Depositional History

Since this is a generalized report directed primarily toward aiding in the study of oil reserves, the Wilcox as discussed will include all sediments between the underlying Midway marine silts and shales and the overlying Reklaw member of the Claiborne.

Thus the Carrizo formation, although usually included in the Claiborne by stratigraphers, is considered here to be a part of the Wilcox group. This is logical since in the subsurface it is indistinguishable from the underlying Wilcox by either electric-log correlations or paleontological markers. For this reason, many subsurface geologists refer to the top of the group as the Carrizo-Wilcox.

Writers describing the Wilcox at the outcrop have commonly used terms such as "heterogeneous series," "cross-bedded," "deltaic," "littoral," "lacustrine," and "discontinuous sediments." Except for the Rio Grande embayment area, these terms apply to a large degree as far downdip as the drill has penetrated thus far.

At and near the outcrop the Wilcox group has been divided into three formations with the Carrizo forming the fourth and youngest formation for purposes of this discussion. The basal formation, termed the Seguin, is represented by thin shallow-water marine sediments deposited by a retreating sea. It is overlain by continental deposits, termed the Rockdale formation, which make up about four-fifths of the group. These sediments are commonly interpreted to have been deposited near the mouth of heavily burdened and rain-swollen streams on a flat coastal belt at least 100 miles in width.

The conditions present during this time are responsible for the discontinuity of many of those Wilcox reservoirs occurring in the middle and lower part of the section. This is particularly true to the northeast of the San Marcos arch in the area encompassed by Railroad Commission District 3.

The uppermost true Wilcox formation, termed the Sabinetown, is essentially of a shallow-water marine nature and is overlain by the Carrizo, ordinarily occurring as a relatively clean quartz-sand unit. The general depositional history of these sediments which dip and thicken gulfward is one of a retreat of the seas during early Wilcox (Seguin) time, followed by extensive deltaic and littoral deposition on a slowly subsiding broad coastal plain during Middle Wilcox (Rockdale) time.

At the end of the Rockdale period, the seas once again advanced, depositing the Sabinetown marine sediments. This was followed by a minor retreat of the seas which resulted in deposition of the Carrizo, probably deposited as near-shore or beach sands.

Minor fluctuations of the shoreline, particularly during early and middle Wilcox time, apparently gave rise to local unconformities which are sometimes detectable in mapping a densely drilled area.

Downdip thickening . . . Evidence that subsidence of the gulf geosyncline was a major structural feature affecting sedimentation is provided by consistent downdip thickening of the Wilcox. At surface it ranges from 500 to 1,200 ft. in thickness, whereas downdip wells have encountered as much as 6,500 ft. of Wilcox without penetrating the entire section. However, lateral or "on

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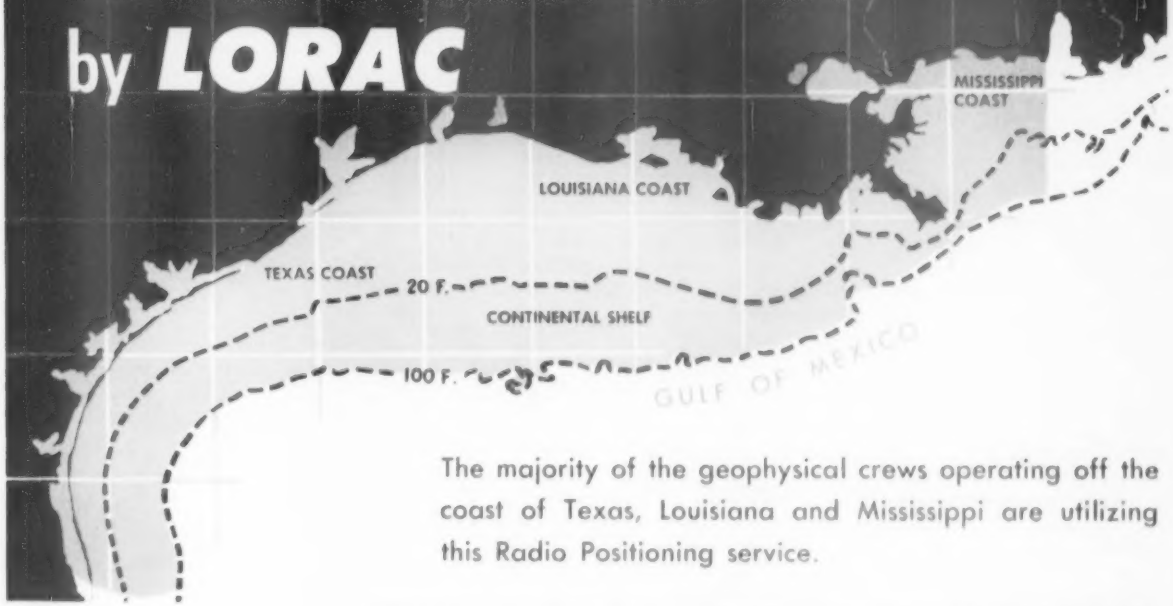

The majority of the geophysical crews operating off the coast of Texas, Louisiana and Mississippi are utilizing this Radio Positioning service.

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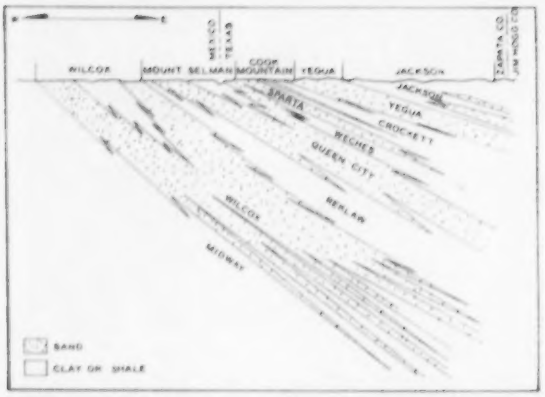


FIG. 2—Diagrammatic stratigraphic section along line AA'. From J. A. Joyce (1954), courtesy Gulf Coast Assoc. Geol. Society.

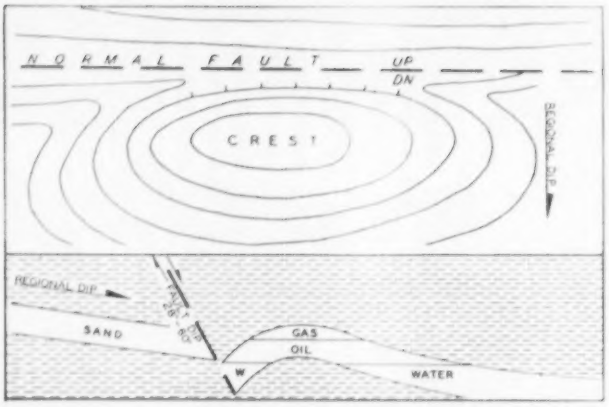


FIG. 3—Generalized updip or downdip structure with possible multiple Wilcox pays.

strike" physiographic elements had their effect on sediment and, consequently, on production also.

Of major importance was a network of river systems in the area now drained by our present-day Colorado and Brazos rivers. These rivers deposited tremendous thicknesses of deltaic sediments. On either side of this great delta system lay interdeltaic provinces whose marine facies shales and clays interfinger with deltaic sand masses. As the Rio Grande embayment area is entered, increasingly marine sediments are found, indicating made rapid subsidence in this area during deposition than for the remainder of the Texas Gulf Coast (Fig. 2). Recent wells in central Webb County have encountered a predominantly marine Wilcox section.

Structure

Carrizo - Wilcox contours (Fig. 1) parallel the present coast line rather closely. Coastward dip averages about 150 ft. per mile, although showing a tendency to increase in rate at about the (—9,000-ft.) contour. From this point updip to about the (—7,000-ft.) contour, several major structural changes take place. Here the overlying Claiborne sediments undergo a rapid increase in rate of gulfward thickening, a major strike fault trend is developed, and the Wilcox sediments themselves apparently increase their rate of thickening radically. This fault or flexure system is often referred to as the "downdip Wilcox trend" and includes an overwhelming preponderance of the Wilcox fields (Fig. 1). The faults are normal tensional features and practically all have their downblock on the coast side. They are generally in more or less parallel alignment. Correlative sections are usually longer on the downside of each successive block, thus indicating that the faults were existent and in active movement during deposition.

Almost every structure in this trend is associated with faulting, and in many cases the faults are obviously the controlling factor. Slumping on the downside of the fault apparently helps account for the northwest reversal of regional dip on many of these closures (Fig. 3).

Evidence that these structures grew throughout Wilcox time is provided by divergence of dip off the crest. A series of structure maps on different horizons usually reveals steepening of flank dip and increased closure with depth. Several of the anticlines producing from the lower Wilcox horizons are entirely lacking in closure at the top of the Wilcox. Other closures apparently owe their effectiveness in part to having permeable sands faulted up against impermeable shales. This type structure most commonly produces from the upper members of the group and is shown in its basic form by Fig. 4.

A trend of faults, upthrown to the coast (through Atascosa, Wilson, and Gonzales counties of Railroad Commission District 1, and extending into Fayette County of District 3) has provided a considerable number of shallow Wilcox fields producing from fault traps of the type shown by Fig. 5. Between these two trends, fields are scattered and usually are due to isolated and localized structural conditions (e.g., Falls City field, Karnes County, and Clay Creek, Washington County).

A glance at Fig. 1 reveals a great density of downdip Wilcox oil and gas fields in Live Oak, Bee, Goliad, and DeWitt counties of Railroad Commission District 2. This is in part due to a happy combination of depositional

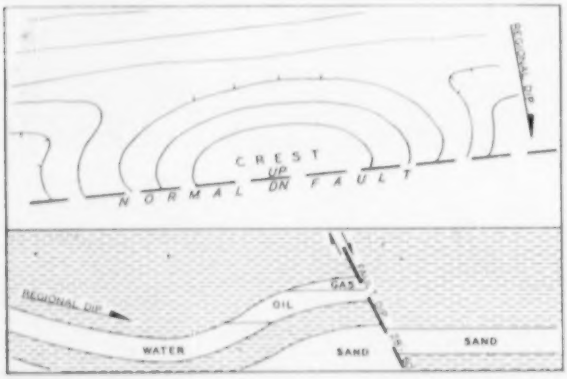
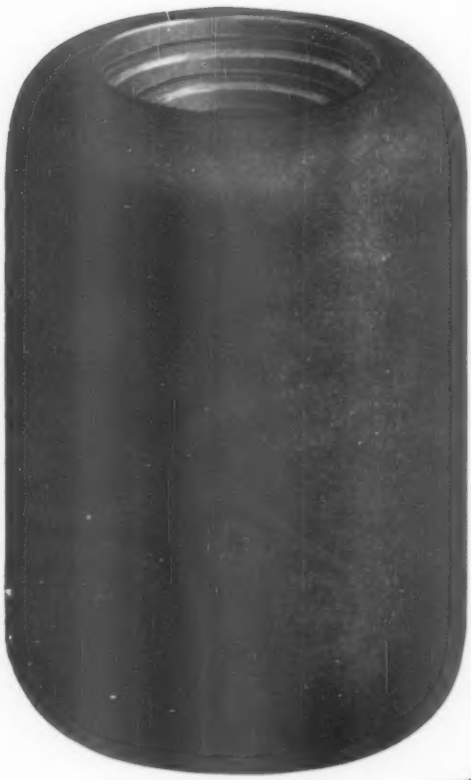


FIG. 4—Generalized downdip structure producing from the upper Wilcox sand.

FIG. 5—Generalized updip structure producing from the upper Wilcox sand.

GUIBERSON DRILL PIPE PROTECTOR RUBBERS



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and structural conditions. A series of well-developed marine-sand members known locally as the Slick, Luling, Mackhank, and first Massive zones occur at the top of the Wilcox. These members are separated by persistent shale members which afford effective seals.

This excellent reservoir condition occurring coincident with the fault-zone structures, which seek to align parallel to the faults, has afforded many traps. As the San Marcos arch is approached, probably near eastern Lavaca County, these sand members (except for the Massive, which itself becomes shaly) disappear. And from that area northeastward, accumulation usually occurs in the more inconsistent deltaic-type deposits mentioned previously.

Of 285 fields in Texas producing either oil or gas from the Eocene Wilcox, 8.1 per cent produce from apparently simple anticlines, unaffected by faulting; 59.0 per cent from faulted anticlines; 7.7 per cent from stratigraphic traps (usually associated with structure); 15.8 per cent from fault closures (faulted nose or doglegged fault); 2.4 per cent from salt domes; and 7 per cent are unknown type traps. Then too, 14.3 per cent of these fields produce both oil and gas, 47.1 per cent oil only, and 38.6 per cent gas only. Also 76.8 per cent produce from the top members of the Wilcox and 23.2 per cent produce from the middle or lower Wilcox sands.

Reservoir Characteristics

Reservoir characteristics are as variable regionally as the sediments themselves. Permeabilities and porosities tend to decrease with depth until commercially profitable production below a depth of 9,500 ft. is uncommon. Many updip areas are fresh-water-bearing and lignitic, thus causing difficult evaluation of sands by electric log. Many Wilcox reservoirs, both updip and downdip, exhibit nearly equal vertical and horizontal permeabilities, often resulting in premature water or gas invasion of thin oil columns. Pressures are generally normal, although abnormally high in some areas below the (—8,500-ft.) datum.

These supernormal pressures are theorized by some to be the result of isolated small reservoirs from which entrapped hydrocarbons were not able to migrate when the sediments gradually subsided to greater depths and were subjected to greater pressures and higher temperatures. At least two factors support this theory. Reservoirs with abnormally high pressures are usually found near the probable downdip limit of the sandstone facies. Also, this type reservoir is commonly lacking in reserves and is depleted rapidly. But there seems to be considerable contradictory data, and the writer does not offer this theory as an accepted solution.

From LaSalle and McMullen counties southward into the Rio Grande embayment, the more marine facies is discouragingly low in permeability and porosity. However, the recent success of formation fracturing has aroused new interest and hope in this area.

ABOUT THE AUTHOR

Lloyd J. Ryman is division geologist in the Corpus Christi area for Continental Oil Corp. A graduate of University of Texas with a B.S. in geology, he started out in 1938 with the Bureau of Economic Geology at University of Texas. After war-time service with the Army's Corps of Engineers, he joined Continental Oil in 1945. He has served the company in South Texas since that time.

This paper is presented by permission of the Texas Petroleum Research Committee.

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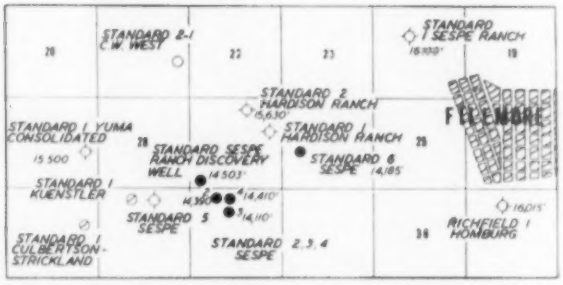
EXPLORATION HIGHLIGHTS

Standard Oil Co. of California has an active development program under way in Fillmore field, Ventura County, California. Location for a 17,000-ft. test 1½ miles north of the discovery well is being graded; surface casing is being run at a deep well 2 miles southwest of the discovery area.



10-Year Patience Paying Off In Ventura's Fillmore Field

by William T. Smith

A POLICY of patience and a liberal purse appears to be finally paying off for Standard Oil Co. of California in Fillmore field near that Ventura County town.

Standard was grading a location for a 17,000-ft. test 1½ miles north of the field discovery well; was preparing to run surface casing in another deep test 2 miles southwest of the discovery area, and was drilling ahead on another wildcat 1 mile west of the discovery well.

More than 10 years elapsed from the time the first wildcat was spudded in and the first successful well was completed in this deep field. That 10-year interval saw Standard drill 76,368 ft. in five wildcats at a cost of nearly $2,750,000 in its efforts to find the field.

Not until April 1954 did the company complete the 14,503-ft. deep 1 Sespe for an initial production of 671 bbl. daily from the interval 14,170-14,235 ft. Since then Standard has completed four other flowing wells while hitting five dry holes in efforts to extend productive limits of the field. (See map).

The first wildcat, 2-1 Fillmore Community, was spudded in on July 1, 1943, and abandoned in July 1944. The 383 days on the 14,512-ft. dry wild-

cat cost Standard close to $500,000. Costs and results didn't improve much on the next try either. This was 1 Santa Paula. It took 363 days from the time it was spudded in in February 1945 until it was abandoned at 11,132 ft.

The discovery well, 1 Sespe, took 249 days to reach its total depth of 14,503 ft. The price tag on this well was close to $750,000.

Discovery of the field gave Santa Clara valley its first commercial production from the upper Pliocene beds. Practically all of the other producing zones in this Ventra County valley are in the Oligocene - Eocene formations. Exceptions to this are the Ojai field, 20 miles west of Fillmore, which is producing from the Pliocene-Miocene age, and Timber Canyon field, which is producing from the Lower Pliocene. Fillmore's producing zone has been labeled the Spalding zone.

As the company has gained added knewledge of drilling conditions, drilling times have been cut about two-thirds. The last successful well, 6 Sespe, took 81 days to complete. It is producing from the interval 14,050-14,180 ft. It was bottomed at 14,185 ft.

So far Standard has been unable to extend the field westward or north. Three wells have been completed less than ½ mile southeast. The other successful well, 6 Sespe, was completed about 1 mile northeast of the discovery well. This last well, possibly a new pool opener, is located NW SW 26-4n-20w. The discovery well is SW SW 27-4n-20w. Drill sites for the other three are grouped close together in NE NW 34-4n-20w.

Standard abandoned two deep tests about ¾ mile north of the discovery well. These were 15,630 ft. and 15,979 ft. deep respectively. A half mile west a 15,500-ft. test was dry and Standard had the same results on a 14,475-ft. wildcat 1 mile farther west. Another company wildcat, 3 miles northwest, also was abandoned at 16,100 ft.

Richfield Oil Corp. abandoned its 1 Homburg last month after taking 153 days to reach total depth of 16,015 ft. This wildcat was located about 3 miles east of Standard's Fillmore field discovery well.

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PACIFIC COAST

CALIFORNIA

Possible New Zone Hit In Midway-Sunset Field

Two formation tests of Exeter Oil Co. 16-1 Exeter-Willmax in the Midday-Sunset field of Kern County indicate company may have scored a new zone discovery. In a 1-hour test, one interval between 4,765-4,972 ft., produced a 4,000 ft. fluid rise consisting of 3,200 ft. of 21°-gravity oil and 800 ft. of mud. In the other interval tested between 4,920-72 ft., oil surfaced in 2 hours. The producing zone appears to be in the Republic sands, source of the bulk of production in Midway-Sunset field.

Seven inch casing was being run to 4,762 ft. in the well which was plugged back from 5,200 ft. to 4,980 ft. The well is located SW NW 16-32s-23e, 3 miles west of Taft.

Standard to Explore Strip

Standard Oil Co. of California will drill two wildcats in the 1½ mile unexplored strip separating the Kern Bluff

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and Ant Hill fields in Kern County. Both will be drilled in 17-29s-29e with one a SW NE location and the other NE SW. Standard will try to tap a possible accumulation between the two shallow depth fields. Kern Bluff production is from Santa Margarita sand at 850-950 ft., while Ant Hill wells produce in Olcese and Jewett sands at 2,200 ft. and 3,600 ft. respectively.

Union Finally Completes San Mateo Discovery Well

After considerable difficulty, Union Oil Co. has completed its new field discovery well in the rugged Boulder Creek area of San Mateo County. The well, 1 Richfield-Costa, pumped 30 bbl. net of 41°-gravity crude in its first 19 hours on production. The perforated interval is 2,060-2,160 ft. which is in the Butano sand of Eocene age. The wildcat, with total depth 3,804 ft., is located SE NW 14-8s-3w.

Northern California Gas Search Continues

The northern California gas search continues with two companies announcing wildcat sites in Colusa and Yolo counties. Honolulu Oil Corp. will drill a wildcat 1 mile southeast of its Princeton-South field discovery well. This new location is SW SW 7-17-1w in Colusa County. Signal Oil & Gas Co. was moving in equipment to drill 6 Signal-Monterey-Reclamation on a site NW SW 20-12n-1e in Yolo County's Sycamore Slough area. Signal also has staked a location for a wildcat 1½ miles southeast of the field in SE SE 28-12n-1e.

Humble Fails to Extend Rosedale Find

Humble Oil & Refining Co.'s first attempt to extend the limits of its discovery well south of Rosedale field in Kern County has failed. This was a 6,500 ft. deep northwest offset to the well which found new production ½ mile south of Rosedale field.

Humble's next try will be a north offset located SW SW 23-29s-26e. The discovery well was completed for 265 bbl. daily of 32.2°-gravity crude through a 12/64-in. choke. The producing interval is in the Stevens zone. Total depth of the well was 6,201 ft.

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HUGOTON EMBAYMENT

OKLAHOMA PANHANDLE

New Morrow Sand Pool Indicated in Beaver

Southwestern Beaver County has a new Morrow sand pool in the making at Warren Petroleum Co. 1 Bowles, SE SE NW 22-1n-20eCM, east of the Camrick oil and gas district.

The discovery gaged 285 M.c.f. of gas at the end of 26 minutes on a drill-stem test in the Morrow at 7,255-81 ft., open 1 hour.

Chester Discovery Reported At West Mocane Field Well

United Producing Co. is testing a Chester-Mississippian well in the West Mocane area, Beaver County. The 5 Adams, C SW NE 36-6n-24eCM, flowed 494 bbl. of oil per day on test through perforations at 6,228-38 ft. On 24-hour test the well made 352 bbl. of oil plus 1,140 M.c.f. of gas through a 1-in. choke. Gas-oil ratio was 3,238 1.

TEXAS PANHANDLE

Important Ochiltree Dual Discovery Is Completed

One of the exploratory highlights of the year for the embayment has been completed in Ochiltree County. The important well is Woodson Oil Co. 1-A Perry Unit.

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ducing from perforations at 7,766-80 ft. Gas flow was 4,000 M.c.f. per day. The well also flowed oil at the rate of 330 bbl. in 6 hours through perforations in the Seven Fingers (Morrow sand) at 7,470-82 ft. The field name is Novi.

SOUTHWEST KANSAS

Casing Set at Cherokee Gas Discovery in Clark

Casing is set at a new gas discovery in Clark County, 15 miles northeast of Ashland and 7 miles north of Morrison field.

The discovery well belongs to Stearns Petroleum and Trans-Era Petroleum Co. The 1 Strodlam, C SE NW 3-31s-21w, flowed gas at the rate of 5,402 M.c.f. daily on drill-stem test at 5,195-5,218 ft.

MID-CONTINENT

OKLAHOMA

Forty Wells Now Producing At West Short Junction

Continental Oil Co. 1 Motter, C SW SW 14-10n-4w, became the 40th producer in Cleveland County's West Short Junction field last week. The well made 144 bbl. of oil per day on 10/64-in. choke from perforations in the Hunton at 8,010-30 ft.

Woods Petroleum Co. 1 Williams, C NW SE 15-10n-4w, became the field's 39th producer, flowing 50 bbl. per hour on 1-in. choke from perforations at 8,012-98 ft.

ARK-LA-TEX

NORTH LOUISIANA

Thick Pay Zone Reported At Rodney Island Well

McCormick, Short, Randolph, and Jett Drilling Co. A-1 A. B. Learned, 11-10n-12e, Rodney Island field in Tensas Parish, flowed 165 bbl. of oil per day on 8/64-in. choke from perforations at 9,265-68 ft. in a 40-ft. sand section. This well is ¾ mile from other producers in the field.

Davis Sand Testing Begun at Cadeville Well

The Davis sand zone of the Cotton Valley is being tested at 10,244-60 ft. at Zach Brooks Drilling Co. A-1 Golson, NW SW 19-17n-2e, Ouachita Parish. This Cadeville field well will test the Davis and then perforated in the Cadeville later at the 9,868-ft. level. There were some gas shows on cores of the Davis sands.

Tokio Gas Discovery Finaled In Claiborne

Trans-Tex Drilling Co. completed the discovery well of Gibsland field in Claiborne Parish, north-central Louisiana.

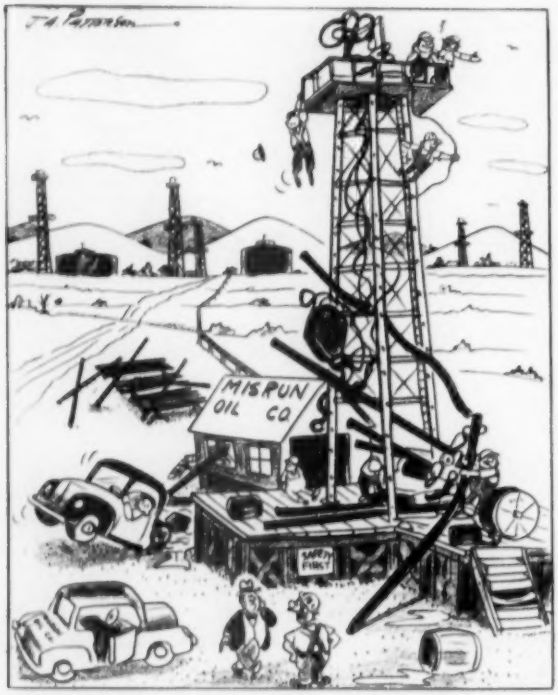
The 1 Drake, C SW SW SE 32-19n-7w, 3½ miles northwest of the town of Gibsland, flowed a calculated open flow of 15,000 M.c.f. per day with some condensate from perforations at 2,820-40 ft. in the Tokio sand.

EAST TEXAS

Wildcat Activity Increase Seen for East Texas Fields

Week's developments in East Texas included new locations for four wildcat tests in as many counties. By county, these were:

Anderson County, Woodbine test B. G. Byars and R. L. Peveto 1 Davey, in S. Rocha Survey, A-663, 3 miles north of Elkhart. Contract depth is 6,000 ft.



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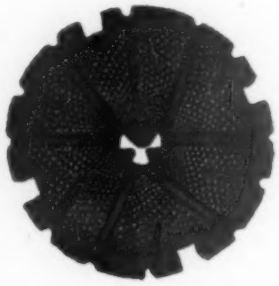

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Cherokee County, Woodbine attempt. Bobby Manziel will start soon on his 2 A. R. Ault, drilling to 5,500 ft. Location is ½ mile northwest of the firm's 1 Ault, dry at 4,783 ft. Location is in the James Ferguson Survey, A-278.

Navarro County, 2,700-ft. Woodbine test. W. J. Carroll and A. J. Hill, Kilgore, will drill 1 Sisson 3 miles southwest of Blooming Grove, on a 127-acre tract in Joseph Knott Survey.

Rusk County, Woodbine try. Sam Barnett 1 Rade Kangerga, R. A. Allen Survey. Location is about 6 miles south of Price.

APPALACHIAN

EASTERN KENTUCKY

A very important wildcat test for southeastern Kentucky has been abandoned as a dry hole with no shows of consequence reported. Benedum Trees 1 Linna Bell Hurst located on Turkey Hole Branch in Bell County reached a depth of 5,697 ft. supposedly in Knox dolomite of Cambro-Ordovician age. Geological tops have not as yet been released. Test was in the Middlesboro basin, an area which has had very little exploration.

In Breathitt County and located on Fugate Creek, Preston Oil Co. is testing oil at the rate of 26 bbl. per day at offset to discovery well completed a few months ago. The company's 1,416 Ervin Turner is bottomed at 1,285 ft. with productive zone being 1,269 ft. to 1,285 ft. in the Maxon (Mississippian) sand.

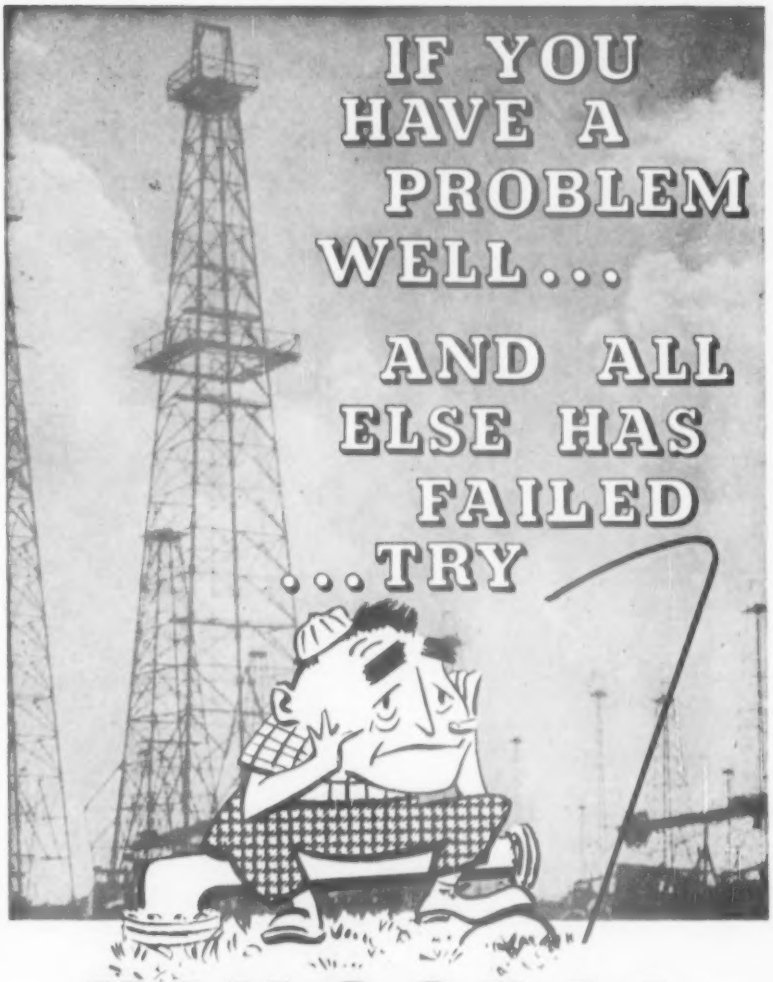
OHIO

Two additions to the south extension of Cottage Hill pool in Hopewell Township, Muskingum County, were completed for the week. Oxford Oil 1 (2) J. E. Fink, Section 6, gaged 250 bbl. daily after fracturing the Clinton, found at 3,202-49 ft. In Section 15, Scott Oil Co. 1 Karl Ramey, gaged 100 bbl. in a 24-hour test after fracturing sand at 3,302-41 ft.

- A good well extended by a location Hanover pool in Hanover Township, Licking County. Waverly Oil Works 15 Cartnel Bros., Lot 14, with Clinto at 2,668-98 ft., gaged 500,000 cu. ft. and 420 bbl. in a 24-hour test after fracturing.
- The area around Layland, on the Coshocton-Holmes County, line, is getting a big play now with 20 or more rigs running.

PENNSYLVANIA

Banks Township, Indiana County, Southwest Pennsylvania. Columbian



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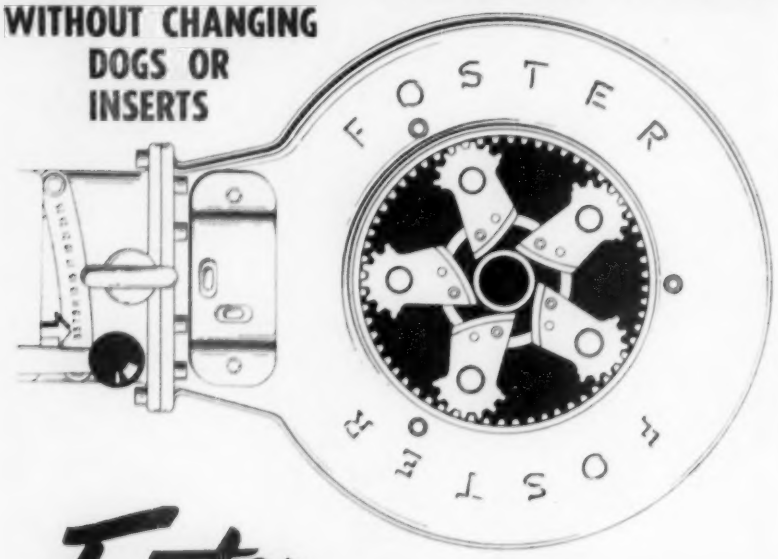

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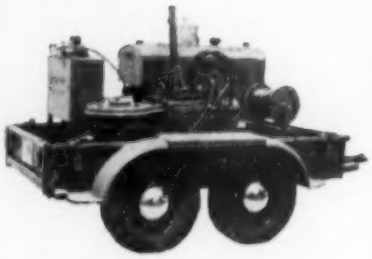

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Northern Well Equipment Co.	Tioga, N. Dakota
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Carbon Co. has started operations at 1831 Farmers & Miners Trust Co., wildcat, Punxsutawney Quadrangle, 1.17 miles south of latitude 40 degrees 55 minutes and 0.28 mile west of longitude 78 degrees 50 minutes.

WEST VIRGINIA

Tygart district, Wood County, West Virginia, H. D. Kinsey et al No. 1 Clarence R. Miller, wildcat, elevation 771 ft., was dry, Corniferous lime at 4,708 ft., Oriskany sand 4,818-57 ft., total depth 4,890 ft.

• Sherman district, Hampshire County, M. E. Anderson 1 J. E. & B. Orndorff is drilling at 6,645 ft.

• Union district, Preston, Cumberland & Allegheny Gas Co. 535 C. R. Lipscomb has resumed drilling and is at 4,628 ft., in the chert. Gas testing 299,000 cu. ft. was encountered in this formation.

GREAT LAKES

MICHIGAN

A deeper horizon oil pay, probably in the lower Detroit River, was under test at an important southwestern Michigan wildcat located between the older Dorr and Salem Traverse oil pools, Allegan County. Pay was found 2,082-86 and at 2,098-2,106 ft. at the Louis Zellman 4 B. Zellman, NW SE NE 25-4n-13w, Salem Township.

On early reports following a 2,000-gal. acidization, well was reported to be continuing to pump and flow at a rate of 18 to 20 bbl. of fluid an hour long after first net fluids started to show. Some water was in evidence, but according to reports, the percentage of oil to water favored completion at this wildcat as a commercial producer.

Before being acidized, well showed for about 75 ft. of free oil and 250 ft. of muddy water in 40 hours. Next day, on a 24-hour fill-up test, hole carried 50 ft. of free oil and about 100 ft. of water. Hole is presently bottomed out at 2,107 ft. A pumping unit will be installed.

While this is not the first deeper horizon test well in the area, it is the first of those drilled in Allegan County to show a dolomite oil porosity zone in this position in the lower Detroit River. Further to the east, Muskegon Development Co. drilled and tested an A-1 Basal Salina oil discovery well in the Dorr Traverse field several years ago. Oil found here was a heavy, black low gravity crude. The oil being recovered from the Zellman wildcat was reported to be a brown crude testing at about 38° to 40° gravity.

Here's Where You'll Be Drilling Tomorrow

Despite a record number of new oil wells, there have been no discoveries of sufficient stature to make an important addition to the nation's reserves

by John C. McCaslin

THIS has been a year of interesting and pioneering exploration. The wildcatters have entered untested regions, establishing production in some, raising hopes in others. There have been more new pools opened, more new pays and extensions in older areas, and more dry holes drilled than ever before.

When the final tally is in, the figures will show a record-breaking number of new oil wells. However, offshore fields excluded, it appears there have been no discoveries of the major field caliber to make a sizable addition to the nation's reserves.

Now that the exploratory year is in its final stages, it is time for a futuristic look at tomorrow's success prospects. Based on this year's discoveries in remote wildcat territory it appears that important development and confirmation work will increase in the next few months in these untested areas. Some older areas that are enjoying success this year are in for even bigger development work next year.

Southeastern states . . . Look for an increase in Lower Cretaceous exploration in southern Mississippi and southwestern Alabama. Two recent discoveries in these areas will give impetus to this search for deep production . . . The California Co.'s strike in Smith County, Mississippi, and Zach Brooks' important Citronelle discovery near Mobile.

Louisiana offshore . . . By year's end a total of 80 active offshore rigs is expected in the Gulf of Mexico. Exploration and development in Louisiana waters and in near-shore areas, one of the exploratory highlights of the year, will continue to give wildcatting in this region a high success ratio. This is the one region that is yielding large new reserves of oil.

Southwest Texas . . . An aggressive Lower Cretaceous campaign is in store for the southwestern end of the Balcones fault zone. Particular areas to keep an eye on are: McMullen, LaSalle, Uvalde, Val Verde, and Maverick counties.

Hugoton Embayment . . . It appears that Hansford County in the Texas Panhandle has stepped aside to make way for a busy exploratory program in Ochiltree County to the east. Recent discoveries are being surrounded with offsets and confirmation trys. This will be the Panhandle's busiest area.

Closely related to the Ochiltree search is the expanding southeastern Beaver County drilling trend in the Oklahoma Panhandle. A key wildcat to watch here is Union Oil Co. of California's 1 Bourquin.

Southern Oklahoma . . . The Bradley-Lindsay and North Madill districts will lead the development race in this region. Wildcatters will be interested in how far the "30-Mile Trend" from Healdton to North Marietta is going. Recent Simpson and Arbuckle discoveries along this northwest-southeast

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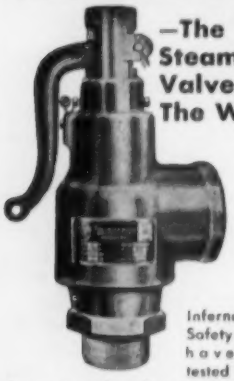

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trend have opened new prospective producing areas for southern Oklahoma. The focal point of this activity will likely be in the Marietta area.

Illinois basin . . . This province has made an astonishing comeback. One of the basin's most successful years is drawing to a close with even brighter prospects for the coming months. The basin's active rigs will be working in the Saline County area of Illinois and in scattered western Kentucky counties. There will be a continued decline in Indiana activity as the region's operators move into southern Illinois and Kentucky in earnest.

Appalachian . . . Fracturing has brought a new era to Ohio and Pennsylvania drilling. Older areas of Ohio are in for real development work next year. One of Pennsylvania's brightest prospects is the Chestnut Ridge anticline area where eight rigs are seeking deep gas production. Look for deep drilling campaigns all through the Appalachian Province.

Nebraska . . . A flurry of new locations has paved the way for large-scale wildcat operations along the Chadron and Cambridge arches. A recent discovery in Hitchcock County will serve as a catalyst for this exploratory work.

Green River basin . . . Indications are that the long-awaited revival in this southwestern Wyoming basin is coming soon. The arrival of the Pacific Northwest Pipeline through the basin will speed up the exploratory race here. The probable big center of drilling activity will be Sublette County.

Williston basin . . . The recent Sohio Petroleum Co. Mississippian discovery in Renville County has revitalized North Dakota exploration. This well, which opened the first producing area in the vast region between the Nesson anticline and the basin's east rim, has sparked an offset program that may decide the future of this new prospective Williston area.

High success-ratios in the Mississippian search in southeastern Saskatchewan have given rise to hopes for an extensive reservoir in this area. Rigwise, it will be the basin's hot spot.

Western Canada . . . Next year's wildcat news in Canada will likely come from the Foothills belt and the Canadian Rockies themselves. There will undoubtedly be some more Sundres and Westward Ho's opened up out on the plains.

West-side Rockies . . . A sizable gas reservoir appears to be building up in eastern Utah and along the western slopes of the Colorado Rockies. Prospects are bright for new oil and gas fields in Grand County, Utah, the center of this important development.

Paradox basin . . . Exploration met with sparse success in this Four-Corners region this year, but interest is still high. It's a big basin and has had little drilling. Drilling is expected to increase soon, particularly in the southeastern Utah sector.

West Coast . . . Over-all drilling in California will remain fairly steady. The most active areas will be the Ventura basin and San Joaquin Valley. Deep drilling is on the definite increase.

In northern California gas exploration is coming in to its own in the Sacramento Valley. A new discovery in San Mateo County in the Santa Cruz Mountains, which could be the most important hit of the year for the state, calls for some development work soon to prove its worth.

West Texas . . . Better seismic techniques and a recheck of older producing areas promise a continued active pre-Permian exploration and development program in and around the Central

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Basin Platform and the Midland basin. Interest in the potentialities of the big Delaware basin is still high.

GULF COAST

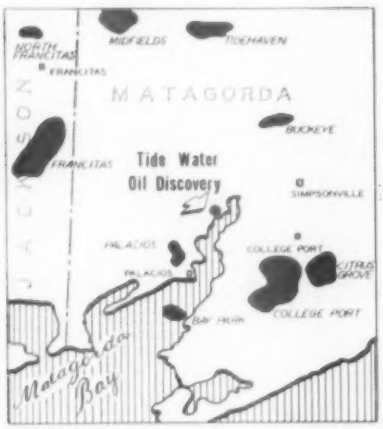
TEXAS GULF COAST

Tide Water Wildcat Opens New Matagorda Field

Tide Water Associated Oil Co. is opening a new oil field in southwestern Matagorda County. Its discovery well, 1 Slaughter, in the R. Lawder Survey, flowed at the rate of 266 bbl. of 46.4°-gravity oil per day during pre-potential tests through 7/64-in. choke.

Flowing pressure gaged 4,800 psi. Gas-oil ratio was 3,050 cu. ft. per barrel. Pay zone is perforated in two intervals, 20 ft. at 10,120-48 ft., and 10 ft. at 10,151-61 ft.

Location is 1 mile north of College Port, at the northern tip of the Tres Palacios arm of Matagorda Bay, and about 2 miles northeast of Palacios field, nearest production.



Arrow points to location of Tide Water Associated Oil Co.'s new oil-discovery well in southwestern Matagorda County.

Nada Wildcat Completed As Gas-Condensate Well

H. J. Chavanne's new discovery well southeast of Nada field, in southern Colorado County, is rated good for 19,300,000 cu. ft of gas per day on open-flow potential gage.

The well, 1 Stovall, is completed in Cockfield sand, perforated at 6,381-90 ft. with bottom of hole at 6,873 ft.

Condensate recovery is placed at 1 barrel to 58,800 cu. ft. of gas. Gravity is 55°. The well is shut in with pressure of 2,359 ft.

Location is in the J. T. Dilley Survey, and near the Wharton County line. It also is about 1 mile west of South Nada gas field, on the Wharton County side of the line.

SOUTH LOUISIANA

Blow-Out Delays Opening Of New Vermilion Field

Drilling & Exploration Co., Inc., and Harry Hurt, joint operators, are cleaning up around their indicated discovery well on the South Kaplan prospect in Vermilion Parish following a blow-out and fire.

The blow-out and fire occurred as operators were preparing to start production and potential tests. Tubing had

Portion of Vermilion Parish showing location of Drilling & Exploration, Inc., and Harry Hurt blow-out discovery-well on the South Kaplan prospect.

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For Details, See Page 15

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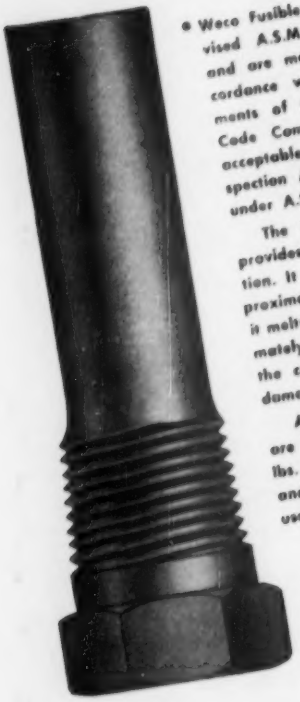

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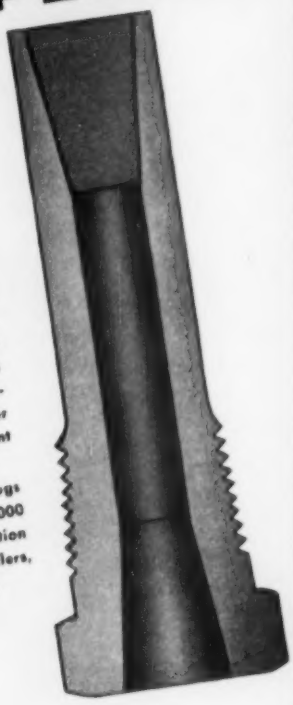

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½" x 2¼"	1093	5 oz.
½" x 2¾"	1087	6 oz.
½" x 3½"	1081	8 oz.
¾" x 2¼"	1091	8 oz.
¾" x 3"	1085	10 oz.
¾" x 3" Lg. Thd.*	1097	10 oz.
¾" x 4"	1079	13 oz.
¾" x 4" Lg. Thd.*	1095	13 oz.
1" x 3-5/16"	1089	12 oz.
1" x 3"	1083	13 oz.
1" x 4"	1077	16 oz.

*1¼" Thread length

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been run and production packer had been set, and drilling mud was being displaced when the well suddenly "kicked."

The well, I Trahan, had been drilled to 11,180 ft. and had casing run to 11,145 ft. after logging rich gas-condensate sand below 11,000 ft. In an open-hole drill-stem test, taking in from 11,039 ft. to bottom, it flowed an ungaged volume of gas and condensate with bottom-hole pressure of 5,500 psi and top pressure of 3,500 psi., through ¼-in. choke.

The discovery is 10 miles southwest of Kaplan, and 2 miles northeast of East Florence field, near the Intracoastal Canal.

WEST TEXAS-NEW MEXICO

G. W. Strake 2 Baker, northern Tom Green County wildcat, flowed 177 bbl. of oil in 16 hours, giving it a 266-bbl. daily potential. Flow was through 16/64-in. choke.

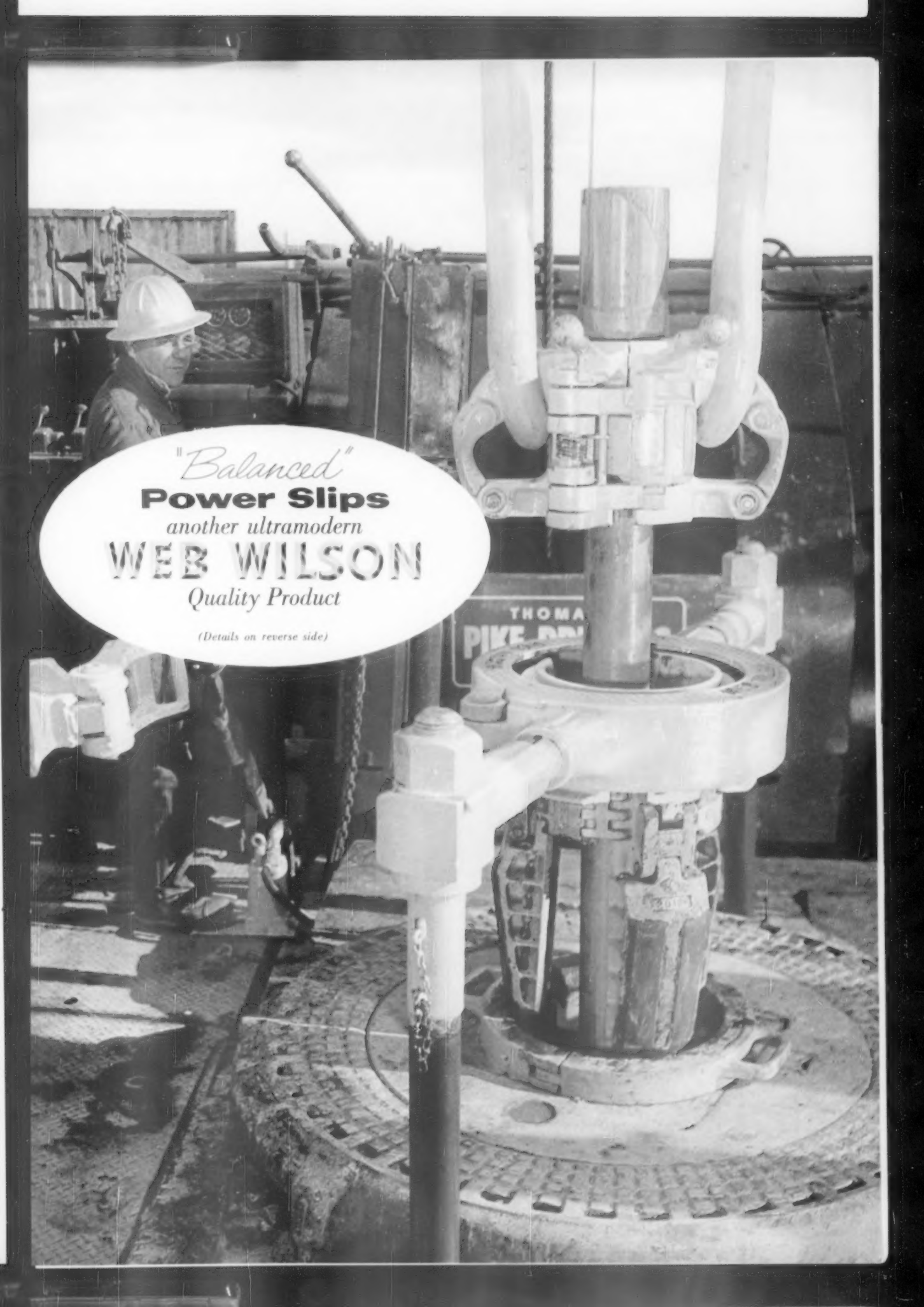
WEST TEXAS

Pennsylvanian Pool Opened In Northern Yoakum

One of Yoakum County's three Devonian projects developed lost-circulation troubles and has been completed as a Pennsylvanian discovery, pumping 178 bbl. of 40° oil a day.

The discovery is John W. Murchison and Meredith Mowery 1 R. L. Cook, Section 83, Block D, J. H. Gibson Survey, 11 miles northeast of Plains. The test, and two others, were projected to the Devonian, or to 12,500 ft. Trouble with circulation developed in 1 Cook at 9,989 ft. and the well was plugged back to 9,780 ft. Perforations at 9,496-9,522 ft. were treated with 10,500 gal. of acid. Gas-oil ratio on completion was 110:1.

The same operators' 1 Cranson, southwest offset, will be drilled to the Devonian, and at this report was in Pennsylvanian limestone at 9,435 ft. The operators' 1 Southland Royalty,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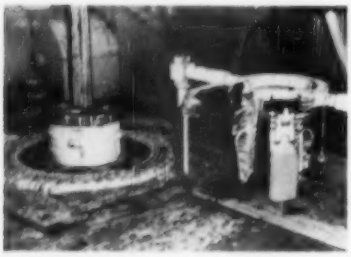
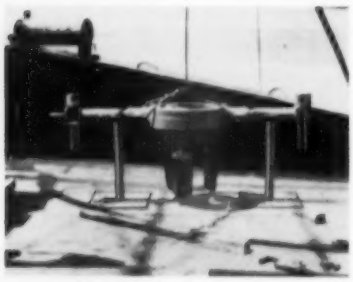
With a touch of his foot, the driller sets or retracts the slips.



The slips can be swung away from the table on either of the two posts; or



lifted and set on a stand. The retracted posts are covered with steel plates.

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The WEB WILSON "Balanced" Power Slip has no cantilever arms extending across the rotary table, but is *permanently* "balanced" *both horizontally and vertically*, when installed, and *no further adjustments are needed.*

"Balance"—which means *perfect, permanent alignment*—permits these slips to *set simultaneously* around the drill pipe, with *positive, uniform gripping* action that ensures safety to the crew, to the drill pipe, and to all rig equipment. There is no unequal stress or strain—no undue scoring—and therefore, no tendency to "bottleneck" the drill pipe.

SIMPLE, PERMANENT INSTALLATION—To install Web Wilson "Balanced" Power Slips, sturdy brackets are welded to the rotary *base* for holding strong supporting posts on opposite sides of the rotary *table*. Although the slips are rigidly and accurately attached, only a few seconds are needed to loosen one bolt and swing the assembly away from the table. If desired when drilling is resumed, the entire Slip Assembly can be quickly released, lifted, and either laid down or placed on a convenient stand out of the way. The cylinders are then retracted, covered with steel safety plates, and the working area is left free and safe.

SAFER FOR CREW AND RIG—than when hand slips are used. Stopping the pipe and setting the slips is controlled by *one* man—the driller—who has a clear view so that he can set the slips safely with minimum danger of "bottlenecking" the drill pipe. The driller can stop the pipe—hold it momentarily—then, with a touch of the foot on the foot pedal, can set the slips. There is no unnecessary shock to score and bottleneck the drill pipe—no jerk, jar, or undue strain on other rig equipment.

These modern "Balanced" Slips offer many other operating advantages and safety features . . . It is never necessary to "strip" the slips over the drill pipe. The assembly is "Free Floating" for rotation with the table without unnecessary cams, bearings or rollers, which cause trouble and expense. The slip segments are inter-connected by strong linkage so that they *set* and *retract* simultaneously, and are held wide open to pass any protectors or tools that will go through the master bushing. Safety Stops prevent dropping of the pistons and setting of the slips in event of air failure. No substructure alterations are required; the slips can be installed in 3½ to 5 hours, without special tools; dismantling for moving is done in a few minutes.

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west offset to the discovery, was drilling below 7,355 ft.

Western Drilling Co., Lubbock, has entered the new area with its 1-A Taylor, offsetting 1 Cranson one location to the east. Contract depth was 9,800 ft., as a Pennsylvanian test.

Delaware shows in Loving . . . Richardson and Bass, Gulf Oil Corp. and TXL Oil Corp. 1 Kyle, projected 15,000-ft. wildcat in northern Loving County, has had oil shows in Delaware sand.

On elevation of 3,059 ft., sample-top on the sand was 4,448 ft. A test from 4,461-4,535 ft. had a strong blow of gas in 8 minutes. Recovery in the pipe was not reported. Drilling continued after the test.

Location of the well is 15 miles northeast of Orla, and about 6 miles east of Delaware sand production in Mason field.

Spraberry Map Available

Oil companies are reviewing the oil possibilities along the Spraberry Trend fields. Shallow production from the Clear Fork, San Andres and Grayburg means a more favorable payout, and even a profit on Spraberry wells *(The Oil and Gas Journal, October 24, 1955, page 56)*.

With renewal of interest in this area, farmouts are more desirable. In line with this new play, Midland Map Co. has an up-to-date Sprayberry Trend map covering the entire area in Midland, Glasscock, Upton and Reagan counties. Ownership and lease data are shown, and scale is 1-in. to 4,000 ft. Re-completed wells are indicated.

This map can be ordered from Midland Map Co., 412 North Big Spring, Midland, Tex.

WESTERN CANADA

ALBERTA

Another Gas Flow Reported At Savanna Creek Well

Husky Oil & Refining, Ltd., Phillips Petroleum Co. of Oklahoma, Northern Natural Gas Producing Co.'s follow-up to the Savanna Creek area gas discovery well yielded another gas flow in the Madison formation at its most recent drill-stem test.

During drill-stem test of interval 8,103-86 ft. at the 2A Savanna Creek located on LSD 5, 21-14-4w5, natural gas flowed to the surface in 5 minutes and increased to a maximum rate of 4,000,000 cu. ft. daily. When pipe was pulled it was found to contain 50 ft. of gas-cut sulfurous mud.

The well lies 33 miles west and slightly south of Nanton town and 65 miles south of Calgary.

During earlier drill-stem tests run in the horizon gas flowed at the rates of 8.4, 9.5 and 7.9 million cu. ft. per day. Coring and testing operations are being resumed below 8,186 ft.

ROCKY MOUNTAIN

NEBRASKA

Banner County Discovery Completed

Petroleum, Inc., has completed 1 Vowers, C SW SW 28-17n-54w, Banner County, for a gage of 124 bbl. of oil per day. Production is from perforations at 5,986-89 ft. in J sand. The well is 4 miles northwest of Travis field.

Kimball County Wildcat Is Apparent Discovery

Watkins Oil Co. recovered 2,067 ft. of oil and 193 ft. of water at 1 Cizek, W½ SW SW 3-16n-53w, Kimball County. Tool was open 1¼ hours at 5,714-27 ft. Flowing pressure was 500 psi. at the end of the test.

The operator has run pipe at the apparent discovery which is 1½ miles northeast of Zoller-State pool.

COLORADO

Wetzel Creek Discovery Testing

Dawson & Cramer, Denver independent firm, has begun swab tests at 1 Kalous, C SE NW 19-2s-56w, Washington County. Swab recoveries are not yet reported. The well is the Wetzel Creek discovery. On drill-stem test at 5,269-85 ft. the operator recovered 3,150 ft. of free oil and 390 ft. of filtrate water. Test was in J sand. Flowing pressure reached 1,305 psi. at the end of the 2-hour test. The discovery is 1½ miles east of Badger Creek, and in line with the trend east of the Little Beaver-Badger Creek axis.

Kiowa County Wildcat Located

Texas Pacific Coal & Oil Co. has made location for a wildcat on the Las Animas arch, about 20 miles southeast of the town of Eads, in Kiowa County. The well is 1 Immer, C SW NW 19-20s-45w. There has been no drilling through the immediate area. Southwest of Eads Continental Oil drilled a small Pennsylvanian gas discovery in 1952, but the well has not been in production.

Tests Started at Morgan County Discovery

Wyoming Oil & Gas Co. has begun tests of J sand perforations at 6,244-69 ft. at 1 Johnson, SW SE SE 15-1n-59w, Morgan County. The well is 2 miles northwest of Park field. On drill-stem test 6,229-50 ft. the well flowed at a rate estimated at 40 bbl. per hour.

MONTANA

Confirmation, Another Wildcat, Staked at Wolf Springs

Atlantic Refining Co. has made location for a second well in the Wolf Springs area of Yellowstone County. The company completed a discovery in Amsden dolomite there earlier this year, but has done no drilling in the intervening 2½ months. The new well is 2 Horton Estate, C SE NW 18-7n-32e. It is a half mile north of the discovery, 1 Horton Estate, C SE SW 18-7n-32e, which was completed for 386 bbl. of oil per day on choke.

Simultaneously announced is a location for a wildcat 1½ miles west of the Atlantic discovery. It will be drilled by Petroleum Producers of Texas at 1 Abel, SE SE SE 14-7n-31e.

The Wolf Springs area is 24 miles south of Northwest Sumatra field in Rosebud County, where one of Montana's most intensive development programs has been in progress during the past 2 years. Production at that field is also from Amsden formations, and the possibility of a similar development at Wolf Springs underlies keen interest in the confirmation.

NORTH DAKOTA

Renville County Confirmation Spudded

Sohio Petroleum Co. is drilling below surface pipe at 1-B Ritter, NW NW 24-163n-86w, in Renville County. The well is a northeast offset to Sohio's discovery at 1 Ritter, SE NE 23-163n-86w, which was completed for 374 bbl. of oil per day.

Shows Cored at McKenzie County Deep Test

Gulf Oil Corp. recovered slight oil shows in core at 9,230-90 ft. at 1 Bennie Pierre-Federal, NW SW 28-148n-104w, in McKenzie County. Drill-stem

test of this interval recovered only mud, with slight oil shows.

The well is 6 miles east of the Montana border, 25 miles southeast of production in Brorson field of Montana's Richland County, and 50 miles west of North Dakota production. It is scheduled to test to Red River at about 13,400 ft. This formation is productive at Brorson, and at other eastern Montana fields in the Williston basin.

Williams County Wildcat Abandoned

Pure Oil has abandoned 1 Esterby, SW SW 11-159n-100w, in Williams County. The failure is 32 miles west of Tioga fields production. It went to total depth of 8,150 ft. with no shows reported in two drill-stem test recoveries from Madison.

WYOMING

New Laramie County Discovery Indicated

C. M. & W. Drilling, Denver, has set pipe and is preparing to test at 1 Wilhelm, C NE SE 30-14n-60w, in the Pine Bluffs area of Laramie County after recovery of oil from J sand. The operator ran test at 7,410-40 ft., and with tool open 1¼ hours, recovery was 200 ft. of oil and 645 ft. of heavily oil-cut mud.

The wildcat is ¾ of a mile northeast of a 1951 discovery which found short-lived production in D sand. The earlier well had J sand shows, but did not produce from that formation.

Sage Spring Creek Area Discovery Completed

Amerada Petroleum Corp. has completed 36 Sage Spring Creek Unit, C NW NE 12-37n-78w, Natrona County, for a flow of 265 bbl. of oil daily. Production is from Dakota at 6,563-70 ft. The well is 4 miles northwest of Dakota production in the older area of the Sage Spring Creek unit. A confirmation well, 37 Unit, C SE NW 12-37n-78w, is now drilling below 4,700 ft.

South Sand Draw Extension Flows

Sohio Petroleum Corp. tested a flow of gas at the rate of 6,000 M.c.f. of gas per day at 1 Government-Downing, SW SE SE 26-32n-95w, in the South Sand Draw area, Fremont County. Test was of Frontier at 5,920-30 ft. The field previously produced gas from Frontier, but production from the formation has been depleted in older producing areas. Oil production is from Phosphoria and Tensleep. The current well is to test to Tensleep at about 8,400 ft.

Successful Wildcats

COLORADO

Weld County: Trigood Oil, E. L. Fundingsland, F. H. Gower 1 State, SW SW SE 36-8n-59w, IPF 150 BOPD, "J" sand, TD 6,566 ft. (Oil discovery.)

KANSAS

Barton County: Honaker Drilling Co. 1 Evers, SE SE NE 24-19s-14w, IPP 204 BOPD, Lansing-Kansas City 3,316-28 ft., 39°, TD 3,495 ft. (Oil discovery).

NORTH LOUISIANA

Claiborne Parish: Trans-Tex Drilling Co. 1 Drake, 3½ miles NW of Gibsland in C SW SW SE 32-19n-7w, IP 15,000 M.c.f. of gas per day plus 2.8 BC per mil., 69.3°, Tokio 2,820-40 ft. TD 2,900 ft. (Gas discovery of Gibsland field.)

Madison Parish: Atlantic Refining Co. 1 E. C. Montgomery, 2¾ miles SE of Lamar field and 1⅞ miles NW of Indian Lake field in 14-15n-9e, IPF 500 M.c.f. of gas per day plus 2 BCPD, ¾-in. choke, Tuscaloosa 5,382-98 ft. TD 5,552 ft. Gas extension to Indian Lake field.)

SOUTH LOUISIANA

St. Martin Parish: Sohio Petroleum Co. et al 1 Johnson et al, 11-9s-8e, Shut-in gas-condensate well, no gage, perforations 10,959-63 ft. TD 11,388 ft. (New pay in Bayou Boullion field).

MONTANA

Pondera County: Western Oils 2 Bills, SW SE NW 31-28n-6w, IP 3,000 M.c.f. of gas per day and 44 BO in 19 hours, Sunburst.

NEBRASKA

Banner County: Petroleum, Inc. 1 Vowers, C SW SW 28-17n-54w, IPP 124 BOPD, "J" sand discovery, new field. TD 6,060 ft. "J" sand.

SOUTHEAST NEW MEXICO

Lea County: Continental Oil Co. 3 Bell Lake Unit, 6-24s-34e, IPP 53 BOPD, 2 BSW, GOR 1,049, 40°, Bone Spring top 8,653 ft., pay 8,670 ft. TD 8,866 ft., elev. 3,628 ft.

Sinclair Oil & Gas Co. 1 Lanehart, 28-25s-37e, distillate discovery in Crosby gas area. Devonian pay 8,434 ft., IP 58,000,000 cu. ft. gas, plus 120 bbl. distillate. TD 8,597 ft.

OKLAHOMA

Pottawatomie County: Big Chief Drilling Co. 1 State, 2 miles west of Centerpoint in NE NE 16-9n-2e, IPP 24 BOPD, domite 5,816-24 ft., 35°, TD 6,038 ft. (Oil discovery.)

NORTH TEXAS

Archer County: L. T. Burns estate 1-C Cowan & McKinney, Blk. 7, Jefferson CSL, 8 mi. S Archer City, IP 85.7 BOPD, 16/64-in., TP 90 psi., 43°, GOR 650, Mississippian 5,242 ft. TD 5,247 ft.

Cooke County: Kay Kimbell 1-A Thrasher, Lot 7, Fannin CSL, 1½ mi. SW Callinsburg, IPP 63 BOPD, 45°, GOR 100, pay 3,500 ft. TD 3,511 ft.

Jack County: F. Kirk Johnson 2 Henderson, T. V. Walden Sur., A-914, 2½ mi. SW Bryson, IPP 46 BOPD, 40°, GOR 750, pay 2,738 ft. TD 3,456 ft.

Lone Star Producing Co. 3 Berry, M. Anderson Sur., A-21, 5 mi. NE Jacksboro, new-pay discovery, IPP 87 BOPD, 43°, GOR 126, Strawn 3,168-72 ft. TD 5,409 ft.

WEST CENTRAL TEXAS

Stonewall County: Allison & Prestidge 1 Mullen, 220-D-H&TC, 5 mi. N Swenson, IPP 60.39 BOPD, 38°, GOR 478, top Ellenburger pay 6,440 ft. TD 6,615 ft.

Taylor County: S. C. Herring Drilling Co. 1 Thornton, Wm. B. Hardin Sur., 2 mi. NW Caps, IP 127.5 BOPD, 14/64-in., 41.6°, GOR 1890, TP 940 psi., Morris sand 4,164-74 ft. TD 5,063 ft.

SOUTHWEST TEXAS

Brooks County: Mills Bennett Estate 18 Mills Bennett est., Palo Blanco Ysidora Guerra Sur. Shut-in gas well, no gage, perforations 5,688-99 ft. TD 6,040 ft. (New pay in Mills Bennett field).

TEXAS GULF COAST

Bee County: Skelly Oil Co. 1 Russell, Refugio County School Land Sur. Shut-in gas well, no gage, perforations 3,535-47½ ft. TD 6,500 ft. (New field—1½ miles south of Sliva field).

Karnes County: Jake L. Hamon and Gilmour Drilling Co. 1 Nance, Sheckler & Robbins Sur. IP 80 BOPD, ⅜-in., 35°, perforations 6,866-70 ft. (Slick sand). TD 7,258 ft. (New field—1 mile northwest of Choate.)

Galveston County: Stanolind Oil & Gas Co. 2-B O.C.S. Lease 0278, Large Tract 144, Galveston area, Gulf of Mexico, IP 15,000 M.c.f. daily (estimated open flow), perforations 6,740-52 ft. TD 8,184 ft. (New pay in GOM-LT-144 field).

Harris County: Standard Oil Co. of Texas 1 O'Leary, Blas Herrera Sur. IP 14,000 M.c.f. daily, open-flow potential, GIR 81.3 M.c.f. per barrel, 59.8°, Yegua perforations 7,797-7,805 ft. TD 8,350 ft. (New field—Northeast Clodine.)

UTAH

Grand County, San Arroyo: Sinclair Oil & Gas Co. 1 Government-San Arroyo, NE SE NW 26-16s-25e, IP 18,500 M.c.f. of gas per day, Entrada gas discovery, new field. TD 5,806 ft. Granite.

WYOMING

Natrona County: Amerada Petroleum Corp. Corp. 36 Unit, C NW NE 12-37n-78w, IPF 265 BOPD, Dakota discovery, new pool. TD 6,571 ft. Dakota.

LEGAL

SEALED BIDS will be received until 2:00 P. M., Mountain Standard Time, November 30, 1955, and opened at that time in the office of the Superintendent, Blackfeet Indian Agency, Browning, Montana, for the leasing of 39,081.36 acres of Tribal land and 320.00 acres of allotted Indian land, located in Glacier County, Montana, for oil and gas mining purposes. The details of lease offerings and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of the Blackfeet Indian Agency at Browning, or call the Agency Land Office, Phone 2561, Browning. Charles S. Spencer, Superintendent.

PERSONALS

Oil Men Pick Curry

Former Far West executive to head R.M.O.G.A. in '56

WILLIAM H. CURRY is an all-around oil man whose abiding love is geology.

Today he's an independent operator with a variety of business interests. But his favorite pastime still is hiking through the mountains looking at rocks. It's an enthusiasm shared by his wife and two sons—and an interest which has paid off handsomely.

He's credited with the discovery of Wyoming's famous South Glenrock field. He also worked up the geology which resulted in the discovery of the Riverton Dome field.

Oil background . . . Curry, the new president-elect of the Rocky Mountain Oil and Gas Association, entered the oil business in 1927 as a plane-table assistant with Shell Oil Co. Before long he was district geologist in San Antonio. He was South Texas chief geologist for Wellington Oil Co. from 1936 until its sale in 1942, then went to the Rocky Mountains for Atlantic Refining Co.

It was in the Rockies that his oil career blossomed. Not long after the Riverton Dome discovery, he resigned as Casper district geologist for Atlantic Refining Co. to help form Far West Oil Co. Three years later he helped organize another firm—Wind River Oil Co. He was vice president of both.

Far West was sold last December to Tennessee Gas Transmission Co. Wind River now has production in Castle Creek and Snyder Creek and has an active wildcatting program under way.

What Curry favors . . . Curry will bring to his new job a conviction that the major problem of the oil industry in his area is public relations. The public, he feels, isn't aware of either the problems or accomplishments of the oil industry, and the industry is a favorite target of important segments of the press.

He also expects to work quietly toward achieving ratable take in the Rocky Mountain states.

His close associates will give odds that he will make a lot of progress toward both goals. He's known as a quiet and affable, yet decisive and efficient, executive. While an oil finder at heart, he has acquired a lot of business acumen. He is, for example, a director of the Casper National Bank and a director of Associated Royalty Co., Denver.

Curry also is a former president of the Wyoming Geological Association and is now serving as a vice president of R.M.O.G.A. He also is a director of the Independent Petroleum Association of America.

Since the sale of Far West, Curry has been operating as an independent. At present he has no rigs and no production, but he's confident that his knowledge of the Rockies' geology will turn up some profitable prospects.

A. L. Thomas has resigned as party chief for Stanolind Oil & Gas Co. to join Southern Geophysical Co. at Midland, Tex., in the same capacity.

Fred Claiborne, safety engineer with Stanolind Oil & Gas Co., has been named general chairman of the petroleum section of the National Safety Council for 1955-56.

Paul L. Berkman, former research associate at Columbia University, has joined the staff of the department of information of the American Petroleum Institute.

F. H. Cummins, former maintenance foreman with Shell Pipe Line Co. at Tecumseh, Okla., has been transferred to Butte Pipeline Co. at Newcastle, Wyo. Shell is part owner of Butte.

Ernest W. Adams has been named superintendent of Delhi-Taylor Oil Corp.'s new Tulsa office which replaces the former Kansas-Oklahoma office at Chanute, Kans. Adams has been in charge of the Chanute office for the past 18 months. **Llewellyn C. Ward** has been named engineer for the new district office.

J. H. (Jack) Berry has been elected president of Devon Drilling Co., Ltd., an Alberta drilling firm. Berry came to Canada in 1949 to organize Continental Supply Co.'s Canadian branch.

H. D. BEDFORD

Henry D. Bedford has been named zone exploration manager of the Rocky Mountain exploration zone of Gulf Oil Corp. He replaces **William C. Lamb,** who is being transferred to Tulsa as division geophysicist. Bedford joined Gulf in the Burbank field in Oklahoma in January 1923 in the production department of the old Gypsy Oil Co. Lamb joined Gulf Research & Development Co. in January 1931. He was transferred to Tulsa in 1951 as geophysical supervisor. He was named exploration manager for the Rocky Mountain zone in 1955.

T. L. Lenzen and **G. L. Parkhurst** have been named to the board of directors of Standard Oil Co. of Cali-

T. L. LENZEN

G. L. PARKHURST

fornia. Lenzen, before becoming a vice president of the company in 1952, had been manager of Standard's Eastern Hemisphere operations. Lenzen, who joined the company in 1928, is also a director of the Bahrain-Caltex group of companies, an affiliate of Standard. Parkhurst, a vice president since 1949, was previously president of Oronite Chemical Co., a chemical marketing subsidiary of Standard. Parkhurst is a director of Arabian American Oil Co. and Trans Arabian Pipe Line Co.

Ralph A. Hockenson has joined Davis Bros. Exploration Consultants, of Tulsa, as manager of secondary recovery and evaluation for the firm. Hockenson began his career with oil firms in 1938 as a district engineer for Ohio Oil Co. at Oklahoma City. In 1950, he went with Carter Oil Co. as assistant manager of the secondary recovery section. **Richard E. Price,** who has served

PERSONALS

with Davis Bros. for the past 5 years as a geologist, has been named manager of exploration for the company.

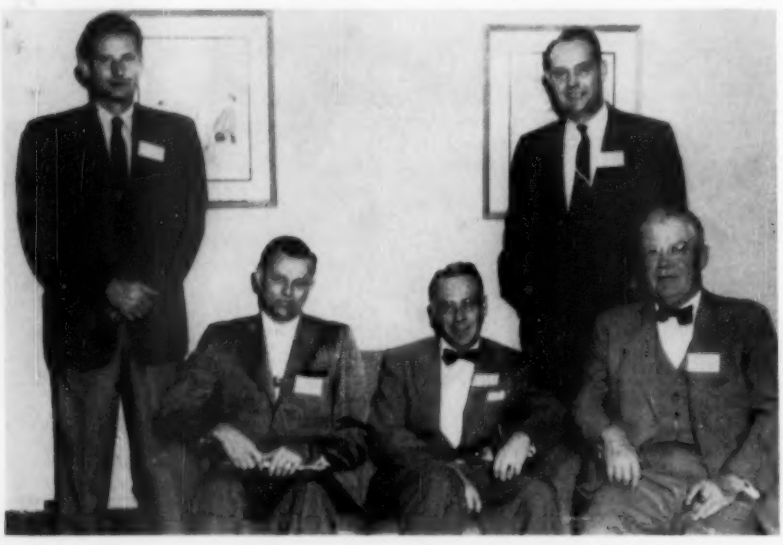
Scott Hughes, first vice president of Southern Union Gas Co., Dallas, has been named a director of the company. **Franklin W. Denius,** Austin, and **John MacGuire,** El Paso, also are new board members. **Willis L. Lea, Jr.,** has been named a vice president of Southern Union. Lea formerly was general attorney and assistant secretary of the firm.

Robert L. Wood, Basin Drilling Co., Midland, Tex., was elected president of the Independent Petroleum Association of America at the organization's annual meeting in St. Louis last week. He succeeds **W. M. Vaughey,** Jackson, Miss. **W. L. Kistler, Jr.,** of W. L. Kister, Inc., Tulsa, was named treasurer. He succeeds **C. L. McMahon, Jr.,** Tulsa. Thirteen new vice presidents were elected. They are **W. T. Woodward,** Taft, Calif.; **M. B. Chastain,** Shreveport; **Jefferson Rebstock,** New Orleans; **A. F. Chisholm,** Laurel, Miss.; **Bayard H. Faulkner,** New York; **Ward S. Merrick,** Ardmore, Okla.; **J. Paul Jones,** Bradford, Pa.; **D. C. Norwood,** Wichita Falls, Tex.; **C. J. Paine,** Dallas; **Lundy O. Allen,** Tyler, Tex.; **R. C. Tucker,** Midland; **L. J. O'Connor, Jr.,** Houston; and **Bruce Anderson,** Casper, Wyo.

Charles A. Buskel, Jr., has been named division gas engineer of the Tulsa production division of Gulf Oil Corp.. Buskel joined Gulf in 1935 and has been connected with the firm's gas - gasoline operations since then. Before being named division gas engineer, he was division plant design engineer.

Henry E. McAuliffe has been named vice president and general manager of Mobil Oil Co. de Colombia. He succeeds **A. D. Graves,** who is returning to the company's New York offices to serve as assistant to the producing committee responsible for Eastern Hemisphere operations.

R. Lee Browning was one of 14 directors recently named by the Oil and Gas Association of Michigan at its annual membership meeting. Other directors named are **John Bruun; Hugh Crider; Robert Devine; O. H. Kristofferson; B. L. Lundin; L. C. MacGregor; Glenn Mannes; E. Allan Morrow; W. M. Saxon; W. Rolland Stewart; George Swan; J. V. Wicklund, Jr.;** and **Harold Wright.**



These Men Will Head Rocky Mountain Association

These men will head the Rocky Mountain Oil and Gas Association during 1956. They were elected at the association's recent annual meeting in Denver. Left to right are: H. A. True, Jr., of True Oil Co. and True Drilling Co., Casper, vice president for Wyoming and South Dakota; Bruce Anderson, Casper independent, treasurer; W. H. Curry, Casper independent, president; Gordon Kirby, Murphy Corp., Billings, vice president for Montana; and T. H. Hammett, Sinclair Oil & Gas Co., Denver, vice president for Colorado and Nebraska. Not shown is J. L. Dougan, Equity Oil Co., Salt Lake City, vice president for Utah and Idaho.

Frank E. Long, former unit engineer with Kirk Field Operating Committee at Eastland, Tex., has resigned to join Ashland Oil & Refining Co. as a production engineer at Oklahoma City.

Dr. Daniel C. Hamilton has been named manager of the economics department of Atlantic Refining Co. Hamilton comes to Atlantic from Standard Oil Co. (N.J.) where he was an industrial economist. **E. T. Knight,** former manager, has been named associate economist.

Thomas A. Hendricks, former division geologist for Stanolind Oil & Gas Co. in Fort Worth, has been transferred

T. A. HENDRICKS

JOHN G. VOIGHT

to the company's general offices in Tulsa as superintendent of foreign exploration. Hendricks' new duties will involve general supervision of foreign exploration other than in Canada. **John G. Voight,** former district exploration superintendent at Tyler, Tex., has been named division geologist for North Texas-New Mexico to succeed Hendricks.

P. V. Keyser, Jr., has been named president of Mobil Overseas Oil Co., a newly formed firm of Socony Mobil Oil Co., Inc. The firm will be responsible for all activities of Socony Mobil in the Eastern Hemisphere and Latin America except for its interest in Standard-Vacuum, interests within major Middle East concessionary areas, and producing operations within Venezuela, Colombia, and Peru. Other officers are: **F. S. Cooper, Jr.,** director and vice president in charge of marketing; **W. G. Corwin,** director in charge of producing; **A. V. Danner,** director and vice president in charge of crude and wholesale sales; **A. C. Ingraham,** director and vice president in charge of supply and distribution; **R. R. Jackson,** director in charge of manufacturing; **W. L. King,** director and general counsel; **F. E. Powell, Jr.,** director and vice president in charge of marine trade; **J. H. B. Wellacott,** director in charge of finance; **A. L. Lanckton,** secretary; **E. J. Glocke,** comptroller; and **F. L. White,** treasurer.

PERSONALS

National Stripper Well Association Names New Officers

Maurice G. Powers, right, president of Bed Rock Petroleum Co., Huntington, W. Va., was elected president of the National Stripper Well Association at its annual meeting in St. Louis last week. He succeeds J. P. Coleman, center, of McCarty & Coleman, Wichita Falls, Tex. Fred Schman, left, retired, of Wichita Falls, was reelected secretary-treasurer. Other officers named were W. M. Shoemaker, Forest Oil Corp., Bradford, Pa., vice president; and H. M. McClure, Jr., Alma, Mich., independent, reelected vice president.

Rodolfo Gonales, research chemist with Cities Service Oil Co. at Linden, N. J., has been promoted to sales engineer in the asphalt division of the firm and transferred to New York City.

Louis Gordon Pope, former geologist with Carter Oil Co. at Worland, Wyo., has been promoted to geologist in the stratigraphic section at Billings, Mont.

James H. Goble, former field engineer with Stanolind Oil & Gas Co. at Levelland, Tex., has been transferred to Fort Worth and named gas engineer.

John H. DeFord, former geologist with West Central Drilling Co., of Abilene, Tex., has resigned to open offices as an independent geologist in Abilene.

Ben C. Belt, retired vice president of Gulf Oil Corp., has been elected chairman of the Texas Research League. He succeeds Hines H. Baker, president of Humble Oil & Refining Co.

Dallas R. Lamont has been elected a director of Socony Mobil Oil Co., Inc. Lamont, who has been patent attorney for the company since 1931, will be in charge of Socony's research and development program. **William M. Holaday,** head of research and development since 1944, has been appointed to the new position of co-ordinator of new product planning.

Leslie A. Leuzinger, former petroleum engineer with Union Pacific Railroad Co., has resigned to join Aeco Corp. as vice president in charge of engineering and operating. Aeco is a West Coast independent.

DEATHS

Francis L. Bishop, 53, consulting geophysicist of Tulsa, died recently at his home after suffering a heart attack. Bishop had maintained an office in Tulsa for 16 years. Before coming to Tulsa, he had worked in Dallas and California.

Merle Thorpe, 76, member of the board of directors and director of business development for Cities Service Co., died October 31 in Washington after a lengthy illness. Thorpe went to Cities Service in 1944 after a brilliant career in radio, advertising, and newspaper publishing. He was most widely known for his role in building the U. S. Chamber of Commerce magazine, Nation's Business, to a leading position in the publishing field. He was its editor and publisher from 1916 to 1944. He founded the first school of journalism at the University of Washington and in 1925 was awarded the Harvard-Bok award for the best ad written during the year.

Alvin Tribe, 72, well known in the California oil industry for his lucky strike in the Poso field, died recently at his home in Redwood City, Calif. Tribe was a cigar store operator when he won a Government lottery and was awarded 160 acres of land. The land turned out to be one of the richest in Kern County. He leased the land to Union Oil Co. and realized a fortune from the property earnings.

W. E. Grisso, 81, pioneer Seminole, Okla., oil man, died October 31 after suffering a stroke. Grisso, who came to the Seminole nation in 1903, rose to riches during the great Seminole field oil boom. He later became one of the state's most prominent civic leaders.

William Z. Dozier, 75, independent oil man and a former vice president of Gilcrease Oil Co., died October 30 in a Tulsa hospital. He left Gilcrease in 1931 and continued to operate as an independent until he retired in 1950. He was quite active in the East Texas and Mississippi fields.

Walter F. Buaas, 66, pioneer Kern County, California, oil man, died recently at his home in Reno, Nev. Buaas, who moved to Nevada when he retired several years ago, was formerly president of Taft Well Drilling Co. in Taft, Calif.

Warren L. Meeker, 52, California oil producer, died in Los Angeles October 28, after a lengthy illness. Meeker had been active in the Huntington Beach and Sunset Beach developments.

William Howard King, 44, Abilene, Tex., independent oil operator, was killed October 26 in a car accident near Brownwood, Tex. King had extensive holdings in Upton, Midland, Callahan, and Brown counties in Texas.

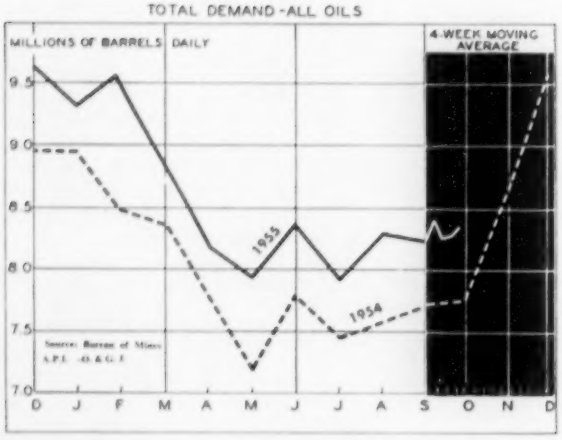
John L. Cochran, assistant manager of the crude-oil department of Eastern States Oil Refinery, died October 29 in a Houston hospital.

Ernest Jacob Koenig, 69, independent oil operator at Tyler, Tex., during the East Texas boom, died in Dallas October 30.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,743,075	DOWN	33,500	UP	621,919
Crude stocks	257,030,000	UP	1,896,000	DOWN	16,265,000
Completions	1,083	UP	9	UP	76
Refinery runs	7,476,000	DOWN	1,000	UP	579,000
Gasoline stocks	151,607,000	UP	71,000	UP	1,818,000
Distillate stocks	151,566,000	UP	1,680,000	UP	14,511,000
Residual stocks	46,299,000	DOWN	342,000	DOWN	10,093,000
Four-product stocks	385,908,000	UP	1,001,000	UP	4,444,000
Total imports	1,113,900	DOWN	75,800	UP	143,300



Gasoline Price Increase Rumored Despite Continuing Price Wars

GASOLINE continued as the market paradox at the end of October. Price wars continued to spread in some areas, appeared to be moving toward settlement in others, and were unchanged in still other districts.

Rumors spread over most of the Mid-Continent and North Central areas during the last week of October that tank-wagon prices for gasoline would be raised in the Dakotas, Minnesota, Nebraska, Iowa, and perhaps in Missouri. So far, there has been no official announcement of these price changes, but the rumor has tended to lend a little extra strength to the Group 3 market.

A gasoline price war at the service-station level continues in the Minneapolis-St. Paul area of Minnesota. It was reported that a private-brand distributor in the area who buys on the open market has closed all of his controlled service stations.

A tourist reported buying gasoline at a service station during a price war in southern Indiana at a price that would leave little more than basic refinery costs after state and federal taxes were deducted.

In Oklahoma City, some dealers are complaining that others are selling gasoline at or below actual costs.

These price wars have not been factors in the high gasoline demand for this year but they have cut sharply into dealers', jobbers', and refiners' profits.

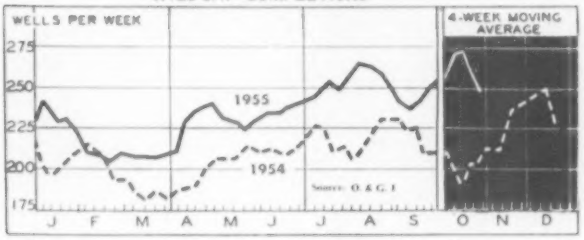
Some recognition is being given to the increasing cost of adding octanes in the Mid-Continent. Last year the spread between regular and premium gasoline at the refinery level was 1.0 cent a gallon. In the spring of this year, the difference was increased to 1.25 cents, and at the end of October the price of premium was raised another 0.25 cents, to bring the spread to 1.5 cents.

At one time, marketing departments were credited with an extra cent on sales of premium gasoline because of the extra cost of handling and selling, while the refiner got the other cent for building extra quality into the product. Now the dealer doesn't have to push premium gasoline, but the refiner is finding it much more expensive to make. It is logical for the refiner to be credited with a larger portion of the price differential.

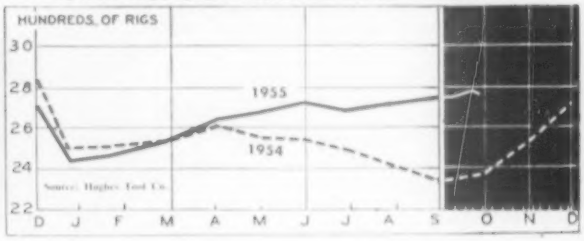
Natural gasoline moved up 0.5 cent a gallon for the Group 3 area on November 1, but the North Texas market did not follow immediately because of the influence of slow offshore movement out of the Gulf Coast. The normal differential between North Texas and Group 3 is 0.5 cent a gallon which is related to the difference in freight rate for northern movement. If there is very much delay in raising the North Texas price, noncontract material in Texas with prices based on North Texas quotations will tend to move to the Group 3 market. Except for material in the terminal areas of the Gulf Coast, natural gasoline has been tight for about 2 months.

Pennsylvania Grade crude advanced 15 cents, 14 cents, or 5 cents depending on the grade, effective November 1. Bradford crude now brings $3.75 compared with $3.35 on November 1, 1954. Zanesville crude advanced 5 cents a barrel. Buckeye and West Virginia moved up 14 cents, and all other grades were boosted 15 cents.

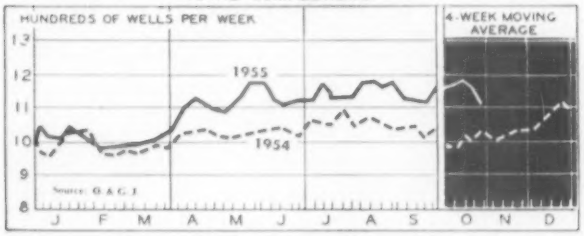
WILDCAT COMPLETIONS



ROTARY RIGS OPERATING IN THE UNITED STATES



TOTAL COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	10-31-55	Change from 10-24-55	Change from 11-1-54
Gulf Coast	586	—21	66
N. and W. Texas-New Mexico	913	2	190
Arkansas-N. Louisiana-E. Texas	173	—1	—4
Oklahoma	359	10	70
Kansas-S. Nebraska	182	—2	26
Illinois-Eastern	145	—2	11
Rocky Mountain	270	—7	29
Pacific Coast	142	—4	11
Total United States	2,770	—25	399
Western Canada	186	—17	15

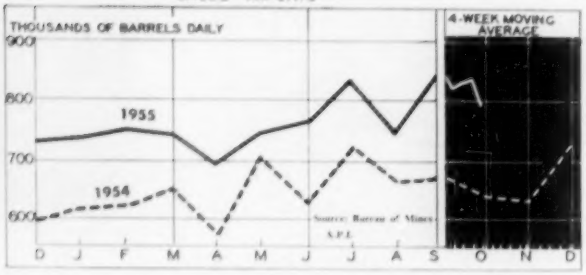
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED OCTOBER 29, 1955

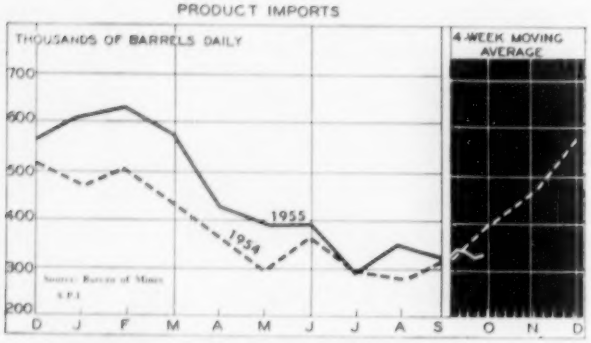
	Total of all wells: Comp.	Oil	Gas	Dry	Footage	Cum. 1955	Cum. 1954	Wildcat completions and discoveries: Oil	Dist.	Gas	Dry	Total	Cumulative total, 1955: Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	1	0	0	1	4,100	65	89	0	0	0	1	1	1	0	0	62	63
Arkansas	19	11	0	8	48,489	665	511	0	0	0	3	3	31	1	4	142	178
California	32	21	0	11	117,926	2,021	1,969	0	0	0	9	9	37	0	11	361	409
Colorado	23	7	1	15	125,392	1,231	1,077	1	0	0	6	7	38	0	22	609	669
Illinois	78	41	1	36	177,799	3,206	2,390	3	0	0	9	12	57	0	4	459	520
Indiana	14	7	1	6	26,611	600	680	0	0	0	4	4	11	0	0	228	239
Kansas	101	43	9	49	356,296	4,162	3,715	1	0	0	16	17	116	1	30	687	834
Kentucky	34	23	0	11	42,014	1,289	941	1	0	0	7	8	48	0	9	261	318
Louisiana	79	40	8	31	582,595	3,313	2,849	0	2	0	9	11	97	69	26	373	565
North	32	15	7	10	114,229	1,706	1,557	0	2	0	4	6	22	10	4	153	189
South	47	25	1	21	468,366	1,607	1,292	0	0	0	5	5	75	59	22	220	376
Michigan	9	7	0	2	25,934	445	470	0	0	0	0	0	9	0	1	174	184
Mississippi	12	6	0	6	96,190	369	344	0	0	0	4	4	14	0	0	130	144
Montana	12	2	0	10	43,711	320	261	1	0	0	7	8	12	0	1	124	137
Nebraska	21	3	0	18	110,873	723	363	1	0	0	14	15	38	0	1	299	338
New Mexico	33	18	11	4	146,511	1,394	903	2	0	0	1	3	34	2	9	94	139
Northwest	11	0	11	0	40,415	466	321	0	0	0	0	0	5	1	9	27	42
Southeast	22	18	0	4	106,096	928	582	2	0	0	1	3	29	1	0	67	97
North Dakota	4	2	0	2	30,103	211	249	0	0	0	2	2	6	0	0	53	59
Ohio	32	17	6	9	55,040	1,005	934	0	0	0	0	0	3	0	7	16	26
Oklahoma	141	99	3	*39	469,304	7,001	7,339	1	0	1	6	8	121	15	25	550	711
Pennsylvania-New York	26	8	9	9	46,685	1,261	1,898	0	0	0	0	0	0	0	7	10	17
Texas	374	254	9	111	1,654,156	16,680	15,293	11	2	2	72	87	647	90	109	3,413	4,259
Southwest (1 & 4)	46	16	2	28	194,720	2,565	2,139	0	0	1	18	19	99	30	33	652	814
Gulf Coast (2 & 3)	50	30	3	17	338,576	2,084	2,158	2	2	1	13	18	75	48	35	549	707
East (5 & 6)	16	8	0	8	82,047	811	810	0	0	0	7	7	21	4	8	273	306
North Central (7-B & 9)	117	66	2	49	414,784	6,239	5,820	5	0	0	29	34	316	0	14	1,352	1,682
West (7-C & 8)	119	111	1	7	543,873	4,105	3,550	4	0	0	5	9	132	1	10	559	702
Panhandle (10)	26	23	1	2	80,156	876	816	0	0	0	0	0	4	7	9	28	48
Utah	1	0	1	0	5,806	79	70	0	0	1	0	1	6	0	6	49	61
West Virginia	4	0	3	1	15,263	534	505	0	0	0	1	1	0	0	10	17	27
Wyoming	29	12	3	14	142,258	755	1,049	1	0	0	11	12	22	0	7	175	204
Miscellaneous (Idaho, S. D.)	4	0	0	4	11,766	57	105	0	0	0	4	4	4	0	2	46	52
Total United States	**1,083**	621	65	397	4,334,822	47,386	44,004	23	4	4	186	**217**	1,352	178	291	8,332	10,153
Total previous week	1,074	580	82	412	4,351,210			29	4	3	190	226	1,329	174	287	8,146	9,936
Total October 30, 1954	1,007	545	73	389	4,002,775			20	2	8	176	206	1,183	115	328	7,460	9,086
Western Canada	82	55	3	24	355,361												

Service wells included: *3, 14.

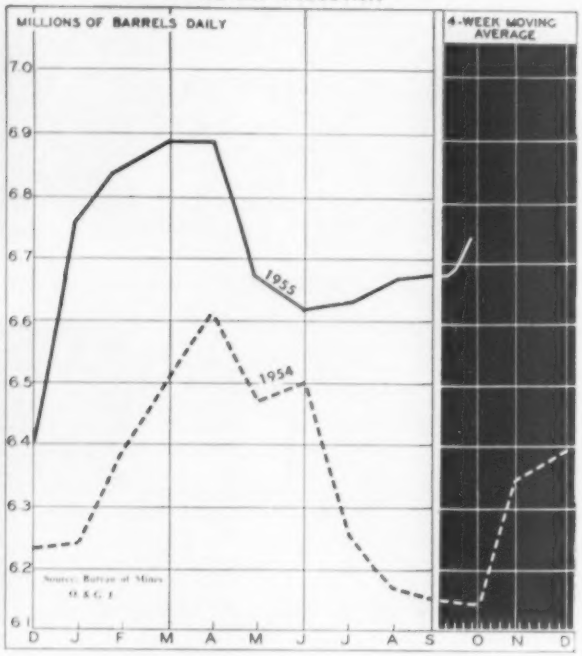
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

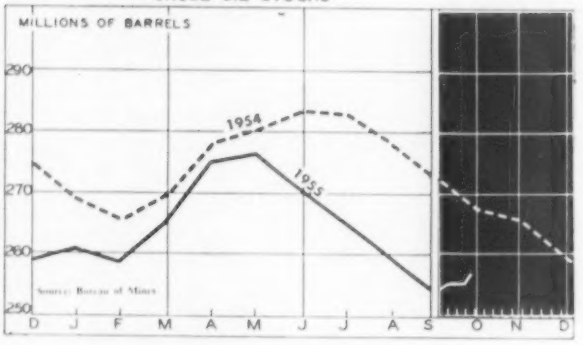


DAILY AVERAGE PRODUCTION FOR WEEK

	October 29 Crude oil	Lease condensate	Total	Oct. 22 total
Alabama	4,200		4,200	4,100
Arkansas	73,550	450	74,000	73,000
California	975,800		975,800	975,900
Colorado	150,000		150,000	150,300
Eastern	50,800		50,800	50,800
Florida	1,375		1,375	1,375
Illinois	231,400		231,400	235,000
Indiana	29,800		29,800	29,800
Kansas	335,000		335,000	337,700
Kentucky	43,400		43,400	42,600
Louisiana	695,900	58,350	754,250	755,400
North	112,900	2,350	115,250	116,400
South	583,000	56,000	639,000	639,000
Michigan	29,150		29,150	31,600
Mississippi	102,900	4,400	107,300	107,300
Montana	41,900		41,900	41,100
Nebraska	28,100		28,100	27,400
New Mexico	226,000	2,500	228,500	228,200
North Dakota	24,800		24,800	32,300
Oklahoma	547,100		547,100	559,300
Texas	2,763,300	48,300	2,811,600	2,811,600
Dist. 1	50,000	475	50,475	50,475
Dist. 2	143,700	7,925	151,625	151,625
Dist. 3	408,000	23,025	431,025	431,025
Dist. 4	237,000	5,100	242,100	242,100
Dist. 5	51,000	400	51,400	51,400
Dist. 6	123,300	4,650	127,950	127,950
East Texas field	212,500		212,500	212,500
Dist. 7-B	149,000	50	149,050	149,050
Dist. 7-C	165,000	4,100	169,100	169,100
Dist. 8	928,800	2,000	930,800	930,800
Dist. 9	205,000	400	205,400	205,400
Dist. 10	90,000	175	90,175	90,175
Utah	6,000		6,000	6,450
Wyoming	268,400		268,400	275,200
Others	‡200		‡200	150
Total U. S.	6,629,075	114,000	**6,743,075**	6,776,575
Change from previous week, down			**33,500**	
Canada	†416,100		†416,100	†424,950
Total U. S. production January 1-October 29			2,034,228,350 bbl.	
Same period last year (crude plus cond.)			*1,915,318,185 bbl.	

*Includes 29,347,425 bbl. condensate. †Week ended previous Monday. ‡S.D. 100. Nev. 100.

CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

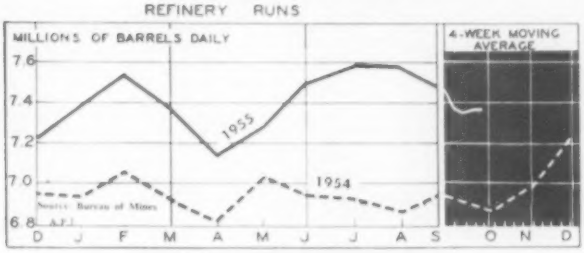
(Thousands of barrels)

	10-22-55	10-15-55	10-23-54
Pennsylvania Grade	3,252	3,284	3,202
Other Appalachian	1,917	1,826	1,843
Illinois, Indiana, Michigan	9,353	9,329	12,706
Nebraska, North Dakota	2,537	2,480	2,032
Kansas	8,063	8,633	8,469
Oklahoma	20,717	20,262	26,707
Arkansas	2,415	2,348	3,006
Louisiana	16,151	16,016	14,617
North	2,461	2,612	2,402
South	13,690	13,404	12,215
Mississippi	3,191	3,119	2,948
New Mexico	7,277	7,313	8,376
Texas	121,846	121,140	127,184
East Texas proper	9,353	9,315	10,461
West Texas	57,167	57,610	57,329
Texas Gulf	25,644	24,354	25,144
Other Texas	29,682	29,861	34,250
Wyoming	14,223	14,285	13,123
Other Rocky Mountain	5,798	4,789	5,650
California	27,150	27,098	32,261
Foreign	†13,140	13,212	11,171
Total	257,030	255,134	273,295

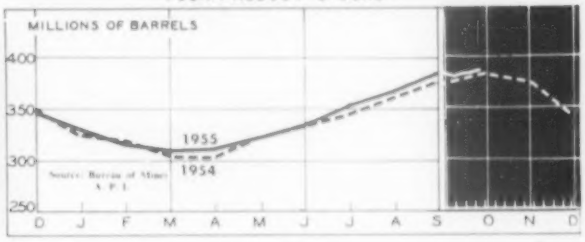
*Bureau of Mines. †Includes 2,548,000 bbl. in California.

CURRENT DATA ON RUNS AND PRODUCTION ARE 4-WEEK AVERAGES

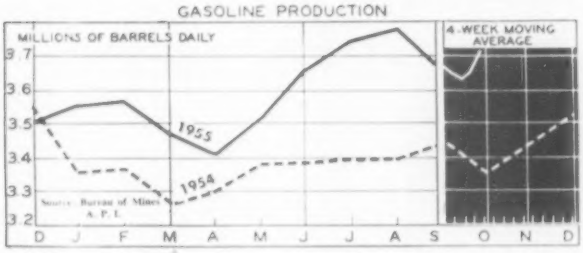
REFINERY RUNS



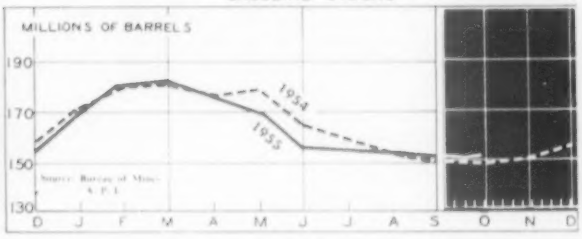
FOUR-PRODUCT STOCKS



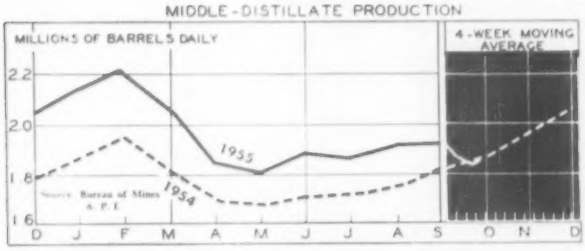
GASOLINE PRODUCTION



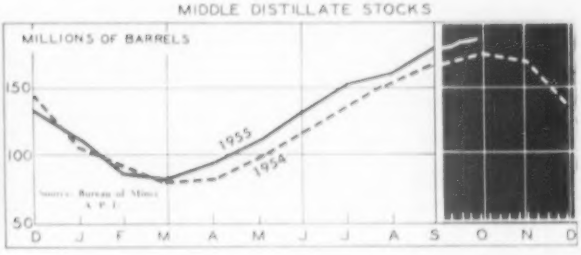
GASOLINE STOCKS



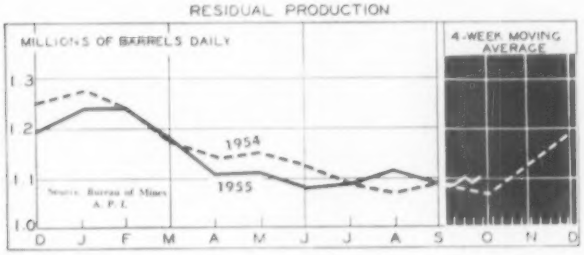
MIDDLE-DISTILLATE PRODUCTION



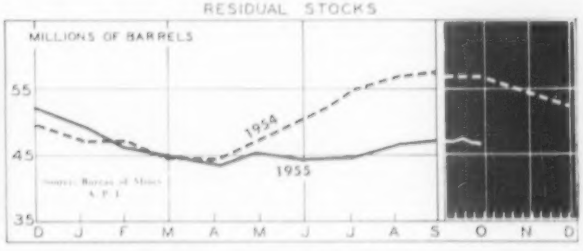
MIDDLE DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



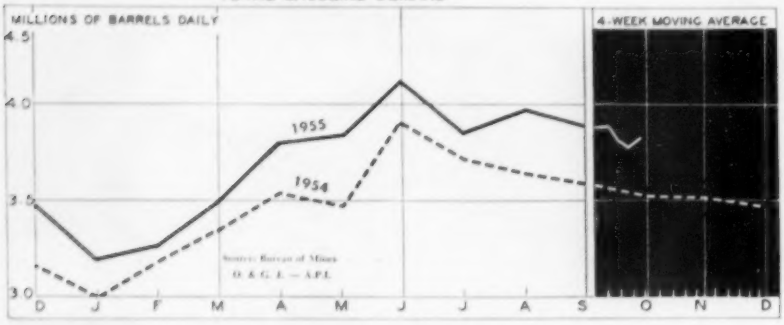
A.P.I. REFINERY REPORT, OCTOBER 28

(Thousands of barrels)

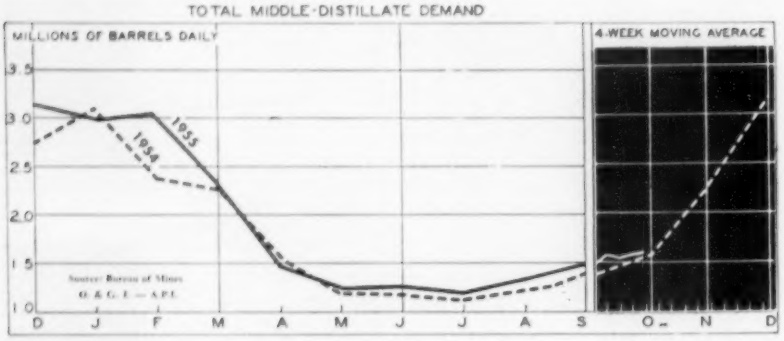
District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks† Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, October 1954 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,087	474.8	29.9	279.7	193.4	35,045	14,984	57,849	13,500	1,006	409.8	24.0	289.0	194.2
Appalachian:														
District 1	101	40.9	2.3	21.1	7.7	4,221	712	3,320	605	97	42.3	6.4	19.0	6.5
District 2	104	44.9	10.0	12.4	15.9	2,414	582	1,162	428	70	36.2	5.9	12.0	6.0
Ind., Ill., Ky.	1,367	780.0	52.1	258.9	181.4	30,843	9,182	29,677	5,147	1,223	660.7	74.1	234.7	148.2
Okla., Kans., Mo.	671	388.4	15.9	150.1	23.9	14,504	2,411	16,100	1,448	608	353.8	13.6	149.3	35.6
Inland Texas	235	186.3	12.3	47.1	20.6	5,467	489	2,888	1,315	232	175.6	8.6	43.5	21.6
Texas Gulf Coast	1,774	896.4	103.9	452.9	244.0	19,625	3,526	16,283	6,891	1,703	809.0	107.0	406.5	226.4
La. Gulf Coast	690	369.6	56.1	162.3	34.9	9,085	2,727	6,314	1,237	582	289.6	54.5	166.4	38.8
N. La. and Ark.	101	33.6	7.0	23.4	6.0	3,930	1,115	2,256	82	91	33.3	7.2	21.0	6.8
Rocky Mountain:														
New Mexico	22	11.0		3.9	2.9	227	4	52	36	14	9.0	0.7	2.1	2.4
Other Rocky Mtn.	241	115.7	1.7	56.0	35.1	4,919	353	2,814	903	214	102.0	3.2	52.7	32.3
California	1,083	526.3	1.7	139.3	350.1	21,327	351	12,851	14,707	994	439.2	4.3	148.6	347.2
Oct. 28, 1955	7,476	3,867.9	292.9	1,607.1	1,115.9	151,607	36,436	151,566	46,299	6,834	3,361.5	309.5	1,544.8	1,066.0
Oct. 21, 1955	7,477	3,726.3	321.9	1,544.7	1,102.4	151,536	36,844	149,886	46,641					
Oct. 29, 1954	6,897	3,418.3	333.6	1,527.0	1,043.6	149,789	38,228	137,055	56,392					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

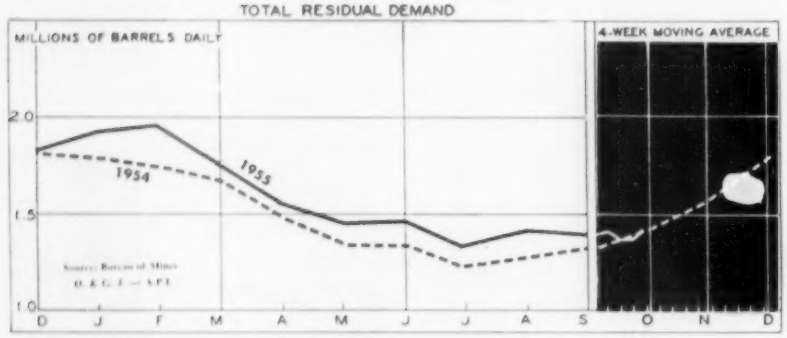
TOTAL GASOLINE DEMAND



TOTAL MIDDLE-DISTILLATE DEMAND



TOTAL RESIDUAL DEMAND



REPRESENTATIVE QUOTATIONS

Spot-market quotations of leading suppliers as of November 2, 1955. Prices are in cents per gallon, except for residual in dollars per barrel and wax in cents per pounds.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	11-11.25	11.5-12	10.5-10.75
Premium gasoline	12.5-12.75	13-13.75	12-12.25
42-44 w.w. kerosine	9.25-9.50	10.05	8.75-9.00
No. 2 straw fuel oil	8.25-8.50	9.55	8.5-8.75
No. 6 residual	$1.75-1.85	$2.55-2.75	$2.10-2.20

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	6.0	5-5.5	5.75
Grade 18-55	7.2	6.1-6.7	6.95

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	19
200 vis., No. 3 neutral, 0-10 pp.	14.25

WAX

Mid-Continent

132-134 A.M.P.	6.0

● Purchasers of Pennsylvania Grade crude raised prices, effective November 1. New postings are listed in the price table to the right. Group 3 prices for natural gasoline moved up 0.5 cent a gallon on November 1. The North Texas price was split but was expected to return to a normal differential before the end of the week. Group 3 premium gasoline is up 0.25 cent a gallon.

PRODUCTION AND DEMAND—MAJOR PRODUCTS

(Thousands of barrels daily)

	Refinery prod.	Total demand
Gasoline:		
Four weeks ended 10-28-55	3,717	3,810
August 1955	3,858	4,033
September 1954	3,450	3,586
October 1954	3,362	3,515
Middle distillate:		
Four weeks ended 10-28-55	1,852	1,594
August 1955	1,910	1,377
September 1954	1,815	1,370
October 1954	1,854	1,509
Residual fuel:		
Four weeks ended 10-28-55	1,103	1,416
August 1955	1,090	1,439
September 1954	1,086	1,319
October 1954	1,066	1,429

CRUDE PRICES GRAVITY SCHEDULE

	Signal Hill, Calif.*	Okla-homa, Kansas	Gulf Coast Tex.†	West Tex.‡
14-14.9	$1.97			
15-15.9	2.03			
16-16.9	2.09			
17-17.9	2.15			
18-18.9	2.21			
19-19.9	2.27			
20-20.9	2.33	$2.50		$2.37
21-21.9	2.39	2.52		2.39
22-22.9	2.45	2.54		2.41
23-23.9	2.51	2.56		2.43
24-24.9	2.57	2.58	$2.91	2.45
25-25.9	2.63	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9		2.76	3.09	2.63
34-34.9		2.78	3.11	2.65
35-35.9		2.80	3.13	2.67
36-36.9		2.82	3.15	2.69
37-37.9		2.84	3.17	2.71
38-38.9		2.86	3.19	2.73
39-39.9		2.88	3.21	2.75
40 and above		2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast. ‡Sour. Includes New Mexico Permian.

Effective dates: California, October 17, 1955; east of California, June 15, 1953; Pennsylvania Grade, November 1, 1955.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	3.75
Middle District	3.62
Southwest Pennsylvania	3.33
West Virginia	3.21
Buckeye Grade	3.15
Zanesville Grade	2.87
Illinois Basin	3.00

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SULLIVAN 200, 5 x 8 pump, 1000' 2⅞" pipe, F-7 with pole trailer, Mayhew 1000 long mast, long kelly, auxiliary power. Fred Butler, Box 481, Pueblo, Colo.

FOR SALE at our Wichita gasoline plant, 11 33-in. O.D. by 43-ft. high welded absorbers filled with 3-in. triple-spiral tile, 450 lbs. working pressure. Also 14 30-in. O.D. by 41-ft. riveted absorbers with triple-spiral pipe, 400 lbs. test pressure. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

FOR SALE: Used R. L. Cardwell Drilling-in Unit. Splendid condition with all accessories and large Doghouse. Located near Wichita. Phone or write John Richard, McClelland Hotel, Wichita, Kansas; or write Box 361, Topeka, Kansas.

13⅜" SEAMLESS steel casing couplings, new, perfect, prime, 8 Rd. Thread. Quantity, very attractive price. Box J-224, The Oil and Gas Journal, Tulsa, Oklahoma.

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SALES AND RENTALS. Used cable drilling and fishing tools, casing, production equipment; from the Southwest's largest stock of oil field supplies. Degen Pipe and Supply, Tulsa.

FOR SALE—Our gasoline plant north of Arkansas City, Kansas. Complete details and price furnished upon request. Contact Patridge, Cities Service Oil, Bartlesville Oklahoma.

FOR SALE—5000' Drilling Rig—Complete for South Texas Drilling—Completely Overhauled—For Price and Complete Inventory write—McKENZIE DRILLING COMPANY 717 WILSON BUILDING, CORPUS CHRISTI, TEXAS.

SEISMOGRAPH CABLE TRUCK with special "Sewall" body using 8 cable handlers (Squirts) and 5 cable bins, mounted on 1952 Dodge Power Wagon. Excellent Condition. Texas Seismograph Company, Box 2089, Wichita Falls, Texas.

FOR SALE: Autocar Diesel C-100, 1949 model. Dual tandem with Braden C-90 winch, in excellent condition, worth the price. Contact Phone #740, or write P. O. Box #346, Sullivan, Indiana.

FOR SALE EQUIPMENT

FOR SALE: Complete Oilfield manufacturing, machine shop and supply business. Write W. N. Young, Box 977, Ada, Oklahoma.

COMPLETE ROTARY RIG, 2000 to 4500 feet capacity. 3500 feet 4½" drill pipe, 7¼ x 14 pump, powered by 1335 Buda, and 350 H.P. V-8 Le Roi Engines. Price, $25,000. Phone DIamond 3-6369, Tulsa, Okla.

BUCYRUS-ERIE Spudder—36 L. Buda engine, butane equipped. Auxiliary leg. Tools from 15½" to 5". Completely equipped and ready to drill. Inventory furnished upon request. Robert J. Orr, 1928 Crestview Dr., Bartlesville, Okla. Phone 5427.

FOR SALE—10,000 feet of new 2⅞" O.D. 10.40# External Upset, Internal Flush, API Seamless Drill Pipe, Grade E. Ends prepared for Reed Super-Shrink Tool Joints. Box H-896, The Oil and Gas Journal, Tulsa, Oklahoma.

1 WILSON TITAN DRAWWORKS 40" double hydromatic brake, three L-3000 Le-Roi gas engines, two pump drives. 1—8"x20" Gardner-Denver slush pump with Rod oiler and V-Belt sheave. For prices of this equipment write P. O. Box 497 or phone MAdison 6-7341, Tulsa.

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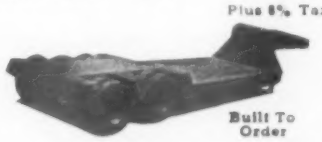
DROP—BED "TYPE" $2,731.48
FLAT—BED "TYPE" 2,638.89

Plus 3% Tax



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$50,000 New Spare Parts for Above.

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1—6' x 58' x ⅛" Chrome-lined, 21 Trays.
1—6'6" x 65' x ⅝", 17 Chrome Decks, 9 Chrome Baffles.
1—3'6" x 49' x ⅞" Shell, 28 Trays, 180#.
1—30" x 34'10" x ¼" Shell, 18 Trays.

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6—1250, 1,000 Bbl. Welded and Bolted.
10—5-8' x 15', 10 x 20', 6 x 20', 5'3" x 38'6", (Chr. Lin. 90#).

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3—Kellogg 3400 sq. ft. Admiralty, 150# psi.
1—Efco Steel Tube 2000 sq. ft., 150# psi.
6—Efco 785 sq. ft. Adm. heat exchangers, 250#.
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8—715 sq. ft., 850 psig, 304 Stls. St.
6—470 sq. ft., 850 psig., 304 Stls. St.
13—715 sq. ft., 125 psig, 304 Stls. St.
6—715 sq. ft. Admiralty 125 psig, 300° F

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1—Lab Petrochem Isoflow Furnace 50,000 BTU/hr.
1—B.J. Hot Oil Pump 3" x 9", 14 stage, 325 gpm, 4620' head, 11-13 nickel chrome impeller, 400 HP st. turbine.
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200,000 ft. 12¾" O.D. x .375 Wall, 49.56#, Lapweld, All Machine Cleaned, Straight, App. 20' SRL, Ends Beveled, Used Good Condition

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GA 350 EMSCO rig complete with two D 17,000 Caterpillar diesel engines, Lee C Moore 126' mast, 7¼ x 14 G-D pump, Two QRC CIW 4,000# preventers & 5 x 10 G-I mud mixing auxiliary pump with Waukesha engine, good condition. Operating in area of Natchez, Mississippi; priced to principals for quick sale, subject to prior sale with or less, 4" OD drill pipe. Wire or call Clinch Drilling Company, Jackson, Mississippi.

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Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units, Westinghouse 20-25-50 KW Generating Units.

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AT-3427—Houston, Texas

CAT MD7 PIPELAYER

Caterpillar Diesel MD7 Pipelayer, serial number 17A1044, equipped with heavy duty track roller guards 3,500 lb. counterweight, rain trap, etc. Used only 320 hours, and in showroom condition. Replacement price—$23,002.15. Our special, special low price, f.o.b. Louisville, Ky. $18,900.00. (Available also for rental or rental option).

Gardner-Denver 600 ft. Rotary Compressor, same age and condition as pipelayer. Price $2,500 under new price.

Whayne Supply Company

Eighth and Main Streets
Louisville 1, Kentucky

Gasoline Plant Equipment For Sale

3—800# 20 MMCF Absorbers with scrubbers, etc.
2—150 HP 350# WP Lucey Oil Country Boilers Complete with Stacks, etc., and Steel Building.
1—30" x 62' Depropanizer with Accumulator, Reboiler and Condenser.
1—Fluor "Counterflo" Induced Draft Cooling Tower Complete.

Other equipment, Instruments, Pumps, Pipe, Valves and Fittings necessary in Gasoline Plant Construction. Detailed Inventory Available upon request.

SOUTHERN PRODUCTION COMPANY, INC.,
P. O. Box 670, Phone FAnnin 8103, Fort Worth, Texas

FOR SALE 8" Line Pipe

IMMEDIATE DELIVERY

400,000 ft. 8⅝" O.D. x .322 Wall, 28.55#, Lapweld, All Machine Cleaned, Straight, App. 20' SRL, Ends Beveled, Used Good Condition.

3,000—8-V Thread Used Couplings, suitable shopping. 8⅝" O.D. Pipe.

SUITABLE FOR
Oil, Water, or Gas Systems,
Water Well Casing, Irrigation Pipe,
Piling or Structural Use

Located: Kansas and Missouri

Large additional quantities same size available soon from present take up and reconditioning operations in Missouri.

Priced Attractively for Prompt Shipment

Humboldt-Chicago Pipe Line Project

125 W. 3rd St. CHerry 2-9128 — **Tulsa, Okla. LUther 4-4229**

FOR SALE EQUIPMENT

ATTENTION Drilling Contractors—FXQ—7¾x16 Gardner-Denver fluid ends complete. Perfect condition, for sale or trade. Contact: Wichita Pipe & Supply Co. P. O. Box 1803, Wichita Falls, Texas. Phone: 3-8197.

EMSCO 250 RIG, complete with Emsco double mast. Excellent condition. 4,000-ft. practically new, 4½-in. drill pipe. Rig now running. Bargain. Phone FOrest 8-5886, 421 Meadows Bldg., Dallas, Tex.

COMPLETE ROTARY RIG, Failing model 2500, trailer mounted, powered by GMC Diesels. 2500' 3½" F. H. drill pipe, 4 drill collars, dog house, fuel tank, water tank, light plant, hand tools, and GMC tandem truck. Contact M & G Drilling Co. 1102 East St. Iola, Kansas. Ph. 1979.

EQUIPMENT WANTED

USED TOOL JOINTS for 2⅞" EUE tubing. Either 8 or 10 thread. W. H. Doran, Jr. Box 648, Alice, Texas.

WANTED—Portable or stationary Hydrostatic Testing machine. Must be in excellent shape. Give full particulars, including price. SOUTH TEXAS PIPE AND SUPPLY COMPANY, Box 3188, Corpus Christi, Texas.

WANTED: New and used bolted type steel tanks, all capacities, also pressure and regular storage tanks. A. Greenspon Pipe Co. Inc. 8890 Ladue Rd. St. Louis 24, Missouri.

HELP WANTED

PROCESS ENGINEER . . . for a modern independent refinery. Need man experienced in catalytic cracking. In reply give history of employment and education. Salary to commensurate with ability. Address . . . Superintendent, P. O. Box 6091, Indianapolis 20, Indiana.

REFINERY SUPERINTENDENT WANTED

for refinery located in Middle West. 5000 barrel crude capacity, 2250 barrel Thermal Cracking, 1000 barrel Platforming, and 1500 barrel Naphtha Unit.

Box J-181, The Oil and Gas Journal
Tulsa, Oklahoma

SALES ENGINEER

Capable of representing country's leading manufacturer of engines for oil field pumping and other auxiliary services. Excellent opportunity for high caliber man. Headquarters Tulsa, territory Mid-Continent. Opening immediately. Please give transcript of experience, and state salary expected. All replies will be treated confidentially.

Box J-209, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

MAJOR OIL COMPANY has immediate openings for two geologists with Mid-Continent experience. Address Box J-202, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEERS—Want young engineers with up to four years experience in drilling, production or reservoir work for immediate employment in Rocky Mountain Area and other points. Salary commensurate with experience and training. Our employees have been advised of this employment offer. Box J-197, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED— Drilling Engineer

Foreign Drilling Operation

Oil well drilling contractor has immediate opening for drilling engineer in Brazil. Liberal salary and bonus.

Drilling and Exploration Company, Inc.

P. O. Box 2—Station "H"
LOS ANGELES 44, CALIFORNIA

Refinery Operators

Foreign Employment

With minimum 7 years' oil refining experience. Must have experience on process units such as crude distillation, thermal reforming, fluid catalytic cracking and reforming and thermal cracking. For refinery operation in Saudi-Arabia.

Write giving full particulars regarding personal history and work experience. Please include your telephone number.

Recruiting Supervisor, Box 85

ARABIAN AMERICAN OIL COMPANY

505 PARK AVE. NEW YORK 22, N. Y.

POSITION AVAILABLE

REFINERY SUPERINTENDENT AND ASSISTANT TO THE MANAGER

for new refinery recently completed in Western Canada. Must have at least three to five years Asphalt Refining experience. Salary open. Reply in detail giving educational background, refinery experience, together with three industry and three personal references. Please enclose picture.

Address replies to

REFINERY OFFICE,
Room 611, Northern Hardware Building,
Edmonton, Alberta, Canada.

HELP WANTED

PETROLEUM ENGINEERS

Graduate petroleum engineers with 3 to 5 years' experience wanted by MAJOR OIL COMPANY for work in the Mid-Continent and Gulf Coast areas in reply, please give resume of experience and salary expected.

BOX J-194, THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

DESIGN ENGINEERS

Permanent Opportunities With

McKEE

In Our REFINERY, METALS or INDUSTRIAL Divisions

at our

Cleveland, Ohio Offices

McKEE with more than 50 years of successful operation, doing business all over the world; is one of the largest, oldest and best known engineering and contracting firms in the business. The McKEE organization continues to grow and expand, thereby offers many present and future opportunities for qualified and experienced engineers and designers in the following fields:

PIPING STRUCTURAL STEEL CONCRETE PROCESS HEATERS EQUIPMENT SPECS.
Also
ELECTRICAL DRAFTS. LAYOUT ENGINEERS PROCESS ENGINEERS

Applicants should have at least five years' of experience.

Here is a rare opportunity for you to utilize your engineering abilities and talents.

McKEE offers top compensation commensurate with experience and ability. No age limitations.

Transportation & Moving Allowances.

PLEASE SEND RESUME TO:
Edward A. Kolner

ARTHUR G. McKEE & CO.
2300 Chester Ave., Cleveland 1, Ohio

WANTED—Petroleum Engineer with experience in all phases production including completions. Small aggressive independent operating in Oklahoma. Excellent opportunity for advancement. Must have B.S. degree. Write giving detail education and experience. Box J-204, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE PETROLEUM ENGINEER—Oil company has opening at Midland, Texas, for aggressive field production engineer, under 38 years of age, with minimum of two years' west Texas experience plus proven ability in testing, drill stems, workovers and completions. P. O. Box 3053, Dallas, Texas.

DISTRICT GEOLOGIST wanted by established oil company for employment in West Central Texas Area. Must have performed the administrative duties of the position and have from seven to ten years of practical geological experience, preferably in the area mentioned. Salary will be commensurate with ability and experience. Reply should state age, education, experience and starting salary desired, and interview will be arranged only upon receipt of such personal data. All replies will be treated in confidence. Our employees know of this advertisement. Reply Box J-220, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Graduate electrical, civil or mechanical engineer for office and field work in pipe line division of major oil company in Middle West. Please state age, experience and educational qualifications. Box J-201, The Oil and Gas Journal, Tulsa, Oklahoma.

JUNIOR GEOLOGIST

Opening November 15 with Independent Oil Company for Junior Geologist with at least 2 to 3 years experience in Oklahoma, preferably with a major oil company. Reply giving full details of past employment, education, and qualifications.

Box J-210,

The Oil and Gas Journal,

Tulsa, Oklahoma.

HELP WANTED

ENGINEERS, DESIGNERS,
DRAFTSMEN

For interesting work in expansion of pipeline, refinery & plant equipment manufacture.

Write complete resume to:

Chief Engineer,
T. D. Williamson, Inc.,
Box 4038, Tulsa 9, Oklahoma.

PARTY CHIEFS
SEISMOLOGISTS
COMPUTERS
OBSERVERS

WORLD-WIDE SEISMOGRAPH CONTRACTING ORGANIZATION

offers technical careers to qualified experienced applicants. Highly attractive starting salaries with good opportunities for advancement within both domestic and foreign areas.

United Geophysical Corporation
POST OFFICE BOX "M"
PASADENA, CALIFORNIA

HELP WANTED

WANTED as Sales Representative. Retired drilling engineer, familiar with mud problems and drilling. Attractive offer. Exclusive territory. P. O. Box 4183, Station A, San Antonio 7, Texas.

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2603, Tulsa, Okla. $5.00 cash.

ENGINEERS

Chemical, Mechanical or Oil Refining

Company has several openings for engineers, with 2 to 8 years experience in design and or operation of processing equipment, for process design position leading to sales. Salary, bonus and excellent working conditions.

Box J-218,
The Oil and Gas Journal,
Tulsa, Oklahoma.

SITUATIONS WANTED

PRODUCTION and Drilling Superintendent with 25 years experience. Desires position with independent. Box J-225, The Oil and Gas Journal, Tulsa, Oklahoma.

LANDMAN: 20 years experience, contracts, leases and titles. Presently employed. Desire Southwest. Box 492, Clarksdale, Mississippi.

THE POSITION YOU WANT: Oil Industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

Well organized, well established oilwell drilling contractor desires the management and supervision of oil properties in West Texas, Central Texas, and New Mexico. Can provide complete handling of oil properties, from acquisition to production. No properties too small, and none too large to handle. Inquiries from independents, groups, small or medium sized oil companies invited. Write, wire, or call collect for further information.

MAKIN DRILLING COMPANY
P. O. Box 1628, Hobbs, New Mexico
Phone 3-3141
146 Allen Building, Midland, Texas
Phone 2-2962

SITUATIONS WANTED

PETROLEUM ENGINEER, 34, married, 6 years experience with major company, primarily reservoir engineering and evaluation. Desire position with smaller company or independent operator. Box J-216, The Oil and Gas Journal, Tulsa, Oklahoma.

REGISTERED ENGINEER, M.Sc., 5 years production, 5 Reservoir experience South, North America. Speaking Spanish. Presently in Texas; desires permanent career in Venezuela. Box J-217, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, petroleum engineer, production superintendent, 25 years experience, all phases oil business. Would like connection with small independent or company. Prefer Rocky Mtn. or Kansas. Now employed. L. A. Box J-195, The Oil and Gas Journal, Tulsa, Oklahoma.

WATERFLOOD ENGINEER: Registered Professional Engineer, experienced in Unitization, Evaluation, Design, and operation of Waterflood Projects. Presently employed, excellent references. Box J-213, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER - GEOLOGIST, fifteen years diversified experience in reservoir engineering, production operations and supervision. Desires position with progressive small company or independent. Box J-214, The Oil and Gas Journal, Tulsa, Oklahoma.

DESIRES RESPONSIBLE Oil Executive Position. Degrees B.S. Petroleum Geology, B.B.A. Major Personnel Management, also Petroleum Engineering, Oil and Gas Law. Experience in Seismograph, Subsurface Geology, 5 years Oil and Gas Taxation with Federal Government. Box J-215, The Oil and Gas Journal, Tulsa, Oklahoma.

PHYSICAL CHEMIST—Ph.D. 3 years diversified research experience in the Petroleum Industry. Desires responsible position with good advancement potential. Box J-219, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT - CONTROLLER. College graduate with 16 years experience in production, income tax, unitizations, partnership operations, IBM application. Present salary $7,800. Box J-221, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT: Age 32, Married, College Graduate. Five years diversified experience with major oil company. Desire position with independent or small oil company. References. Box J-222, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION CLERK—7 years diversified experience in material, Regulatory, and production records. Degree. Available immediately—will relocate. 2715 Penns. Street, Wichita Falls, Texas. Ph.: 7-0773.

GEOLOGIST, Nineteen years experience Oklahoma, Texas and San Juan Basin. Eleven years as District Geologist. Able to supervise Geological Department, Box J-188, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY SUPERINTENDENT—Technical co-ordinator. Proven administrator. Degree. Experienced all phases refining including catalytic cracking and reforming. Box J-226, The Oil and Gas Journal, Tulsa, Oklahoma.

INDEPENDENT or middle size oil company, college graduate, age 27, one year law, two years major oil company. Land experience in Gulf Coast, Louisiana and Texas, commercial multi-engine pilot. Capable of assuming dual flying land position. Box J-227, The Oil and Gas Journal, Tulsa, Oklahoma.

MAP STICKS

ELIMINATE YOUR MAP-HANDLING PROBLEMS! Simply roll your maps on Kraftbilt All-Plastic Snap-On Map Sticks and hold in place with light-weight resilient plastic clips. Bright colored Index Flags plug in one end of each stick, carry labeled identity and instantly "flag" the map you want. Send for new Catalog 1054-B. Ross-Martin Co., P. O. Box 800-A, Tulsa 1, Oklahoma.

OIL FORMS

KRAFTBILT FORMS, designed especially for the oil industry, are popular because they are efficient, economical. For plat sheets, well log strips, columnar pads, all production reporting forms, material transfers, truck reports, all administrative forms, ask for new Catalog 1154-K. Ross-Martin Co., P. O. Box 800-A, Tulsa 1, Oklahoma.

BUSINESS SERVICE

Delaware Corporations formed and serviced. American Guaranty & Trust Company, P. O. Box 487, Wilmington, Delaware.

ELECTRIC LOG CABINETS

FOR ECONOMICAL FILING of full-size electric logs, most geologists prefer Kraftbilt E-24 4-drawer cabinet. Two compartments to each drawer with separate follow blocks make this cabinet handy, economical. For filing reduced electric logs, geologists use Kraftbilt E-28 8-drawer cabinet. Send for new Catalog 1054-B. Ross-Martin Co., P. O. Box 800-A, Tulsa 1, Oklahoma.

BUSINESS OPPORTUNITIES

OIL INVESTMENT BUSINESS—Capital of $75,000 to $250,000 required—$20,000 now, balance as development progresses; Investment about 70% tax dedeuctible. Confidential. F. Heidt, 500 S. St. James, Evansville, Ind.

BUSINESS OPPORTUNITIES

WE HAVE TEXAS CLIENT

Who has asked us to find them from 500 to 5000 barrels per day settled production, Texas, Oklahoma, Louisiana or New Mexico. Inspection can begin within 24 hours. Principals only and in strict Confidence.

COMBEST ROYALTY COMPANY
Amarillo, Texas

Will Buy Producing Oil Properties with low volume daily production for new type of secondary recovery systems. Large Acreage Spreads Not Necessary in our method. Advise what you have available with all details, including price, engineering data, present daily average production, etc. Box J-196, The Oil and Gas Journal, Tulsa, Oklahoma.

LEGAL NOTICE

NOTICE OF SALE OF INTERESTS IN PRODUCING OIL AND GAS PROPERTIES

Notice is hereby given that the undersigned, Wm. B. Prugh and J. D. Land, Trustees of LARKINS-WARR TRUST, an Express Trust organized under the laws of the State of Oklahoma, will offer for sale at public auction and sell to the highest bidder, for cash, the interests of Larkins-Warr Trust, an Express Trust, in four producing oil leases located in the Oklahoma City field, on the 12th day of December, 1955, at 10 o'clock a. m.

The interests of the Trust in the following properties will be combined and sold as a single unit, to-wit:

		Fractional Interest	Net Interest
1 Producing Well	Carney Lease	¼ of ⅞ W.I.	58.33333
1 Producing Well	Goodwin Lease	¼ of ⅞ W.I.	58.33333
1 Producing Well	Katy B-4 Lease	¼ of ⅞ W.I.	58.33333
1 Producing Well	Travis Lease	¼ of ⅞ W.I.	58.33333

These four wells produced 29,733 gross barrels of oil for the first nine months of 1955.

The undersigned Trustees will sell at public auction the above-described interests of Larkins-Warr Trust in the office of the Trust, 907 Kennedy Building, Tulsa 3, Oklahoma, on the 12th day of December, 1955 at 10 o'clock a. m. The Trustees, however, reserve the absolute right to reject any and all bids. A cashier's check, certified check, or cash equivalent to ten per cent (10%) of the total bid accepted shall be paid at the time of sale and the balance due upon approval of title not to exceed ninety (90) days thereafter.

Information concerning the above-described leases, together with all engineering reports and production data, are available for examination by prospective bidders in the office of the Trust.

The interests in the above leases are being sold in accordance with Article VI of the Trust Indenture, dated November 1, 1934, under which said Trust was created. Article VI provides that the Trust shall terminate at the expiration of a twenty-one (21) year period, and the Trustees will then proceed to liquidate and wind up the affairs of the Trust.

DATED at Tulsa, Oklahoma, this 25th day of October, 1955.

Wm. B. Prugh, J. D. Land
"Trustees"

LEGAL NOTICE

NOTICE OF SALE OF INTERESTS IN PRODUCING OIL AND GAS PROPERTIES

Notice is hereby given that the undersigned, Wm. B. Prugh and J. D. Land, Trustees of OKLAHOMA-TEXAS TRUST, an Express Trust organized under the laws of the State of Oklahoma, will offer for sale at public auction and sell to the highest bidder, for cash, the interests of Oklahoma-Texas Trust, an Express Trust, in producing oil and gas properties located in the States of Kansas, Oklahoma, and Texas, on the 12th day of December, 1955, at 11 o'clock A. M., in the office of Oklahoma-Texas Trust at 907 Kennedy Building, Tulsa 3, Oklahoma.

All interests of the Trust in producing oil and gas properties located in each state will be combined and sold as a single unit. The interests of the Trust to be sold are as follows:

TEXAS:

12 Producing Wells in East Texas Field—Full ⅞ths W. I.
1 Producing Well, Van Zandt Co., Texas—30% of ⅞ths W. I.

OKLAHOMA:

5 Producing Wells in Oklahoma City Field—Full ⅞ths W. I.
3 Producing Wells in Oklahoma City Field—Various Interests

KANSAS:

19 Producing Wells in Barton County, Kansas—Various Interests.
2 Producing Wells in Russell County, Kansas—$\frac{1}{16}$nds of $\frac{15}{16}$ths of ⅞ths W. I.
21 Wells located in Barton and Russell Counties, Kansas., are subject to an option to purchase by owners of the remaining leasehold interests.

The Trustees, however, reserve the absolute right to reject any and all bids made during the public auction. A cashier's check, certified check, or cash equivalent to ten per cent (10%) of the total bid accepted shall be paid at the time of sale, and the balance due, upon approval of title, not to exceed ninety (90) days thereafter.

Information concerning the above-described properties, together with all engineering reports and production data, are available for examination by prospective bidders in the office of the Trust.

The interests in the above properties are being sold in accordance with Article VI of the Trust Indenture, dated December 7, 1935, as amended, under which said Trust was created. Article XIX provides that the Trust shall terminate at the expiration of twenty years, and the Trustees shall immediately proceed to liquidate and wind up the affairs of the Trust.

DATED at Tulsa, Oklahoma, this 25th day of October, 1955.

Wm. B. Prugh, J. D. Land
"Trustees"

ROYALTIES

OFFERING CHOICE PRODUCING oil income royalties with large reserves per Dollar investments. A. S. Berry, P. O. Box 1383, Tulsa, Okla.

IN THE HEART of the Williston Basin Landowners Royalties in major company blocks. Landowners Royalties Company, Box 1225, Great Falls, Montana.

LEASE AND DRILLING BLOCKS

CONTACT A. L. Bowles, Box 947, Ada, Okla., for Drilling Deals, Oil Production.

OLD LEASE TO SALVAGE. Worth working over. H. A. Miller, Glasgow, Ky.

WEST TEXAS mineral rights for lease Counties Crockett, Schleicher, etc. For description write Harold Keating, 2023 N Harlem, Chicago 35.

OFFSET DRILLING WELL to oil production. High gravity oil, ⅛—$550, ¼—$1,000 Through Sand. Fastest developing shallow field in state. L. Price, Coweta, Okla.

HAVE DRILLING DEAL IN ILLINOIS, with wonderful geology, that I will sacrifice for $50 per acre, a one-eighth override, and three wells drilled to 3,000 feet within six months. Must be checked to appreciate its possibilities. Do not answer unless you are financially able to carry out the requirements.
Box J-206, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED
Producing Royalties
Settled Production
and
Good Lease Prospects
Send Full Information
H. HALL
Box 1781, Tulsa 1, Okla.

LEASES ROYALTIES
Producing and Nonproducing
Bought and Sold—Any Area
Inquiries Invited
B. D. BUCKLEY
6835 Delmar Ave., St. Louis, Mo.

399 ACRE OIL LEASE. ONLY ¼TH MILE FROM 4000 BARREL DAY WELL. SIMPSON PRODUCTION 4800 FEET.

46 Gravity Oil. Southern Kansas. No dry holes between 4000 barrel well and my lease. Ideal for Tax deal for big Corporation. Perfect titles, good geology. I want action. Well started 120 days. Only five dollars an acre and ⅛th Override, or fifteen dollars an acre and ⅛nd Override. Why take chances. Drill close to production. For details write

Box J-223,
The Oil and Gas Journal,
Tulsa, Oklahoma.

FARMS AND RANCHES

2400 ACRE Ranch & Farm near Laurel, Miss., all fenced and cross-fenced with houses and corrals. Carrying 600 head of cattle. Ideal for fishing and camping. Cost to improve this Ranch was approximately $300,000. Asking $175,000 with part being financed. C. F. Martin, Box 362, Laurel, Mississippi.

WELL RECORDS

FOR SALE—50,000 well completion cards. 5 year set covering a 75 county area in North Central and West Texas. Box J-207, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED

OIL PROPERTIES WANTED. "Oil properties wanted, settled or semi-settled production of 100 to 2,500 barrels daily in Oklahoma and Kansas. Property must stand thorough inspection. Contact Morris Sitrin, 1215 First National Building, Tulsa, Oklahoma with particulars.

WANT 1 TO 4 or more producing oil wells, fairly shallow, or shallow lease with proven locations. Send full details to 1175 California, San Francisco, PR 5-3944.

WILL PURCHASE A ⅛ interest, no promoters, in well to be drilled in S.E. New Mexico. Box 22, Emmaus, Pa.

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LEGAL

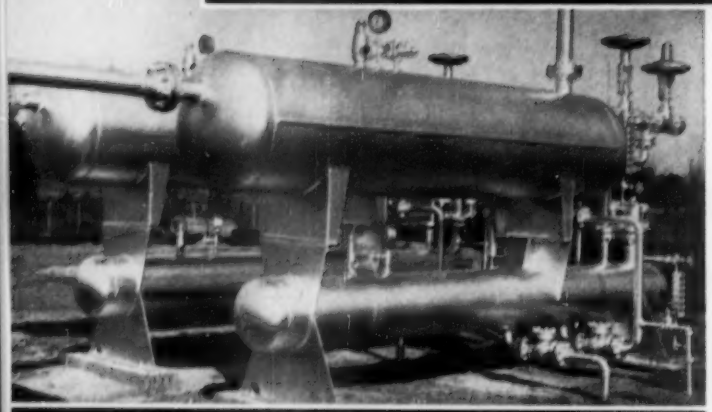
SEALED BIDS will be received until November 17, 2:00 P. M. Mountain Standard Time, and opened at that time in the office of the Superintendent, Fort Belknap Consolidated Agency, Harlem, Montana, for the leasing of 13,247.33 acres of Tribal land and 12,826.23 acres of allotted Indian land located in Townships 31 and 32 North, and Ranges 22 and 23 East, Principal Meridian, Montana, County of Blaine, Montana for oil and gas mining purposes. For further detailed information and a list of lands advertised call or write: Darrell Fleming, Supt. Fort Belknap Consolidated Agency, Harlem, Montana.

LEGAL

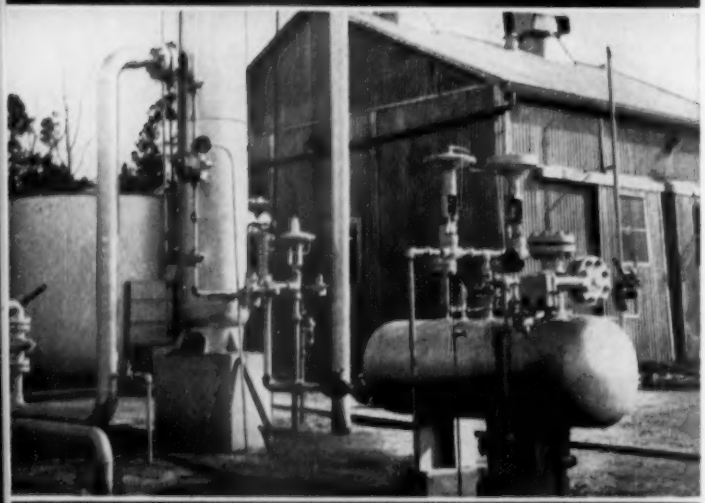
U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Land Office, Cheyenne, Wyoming. Notice is hereby given that approximately 2958.48 acres of land in nine parcels within the known geologic structure of the Midway Field, Wyoming, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 2:00 P. M., MST, December 15, 1955, when bids will be opened. Successful bidder(s) will be required prior to issuance of lease(s) to reimburse the Bureau of Land Management a proportionate share of the amounts advanced for costs of publication. Details of the lease offering, and how and where to submit bids, may be obtained from the Land Office, Cheyenne, Wyoming. Perry T. Williams, Manager.

National

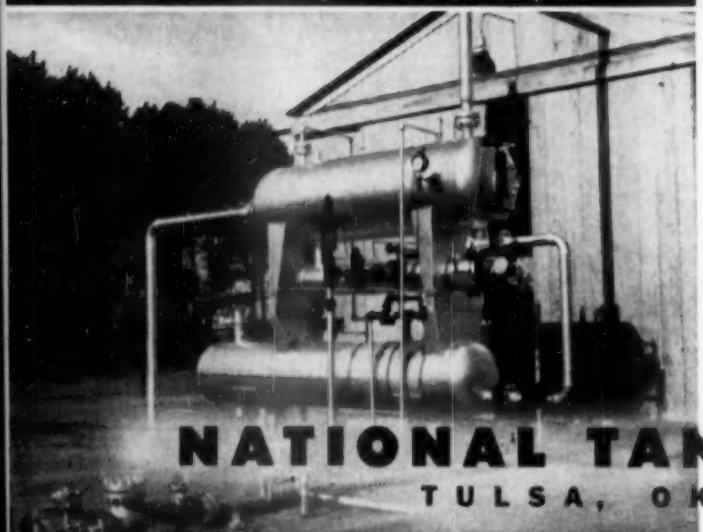
COMBINATION SEPARATOR & FLUID BOOSTER



2—30" 500 PSI Oil and Gas Separators with 16" 1200 PSI BOOSTERS. Compressing gas at this site from 350 PSI to 1100 PSI.

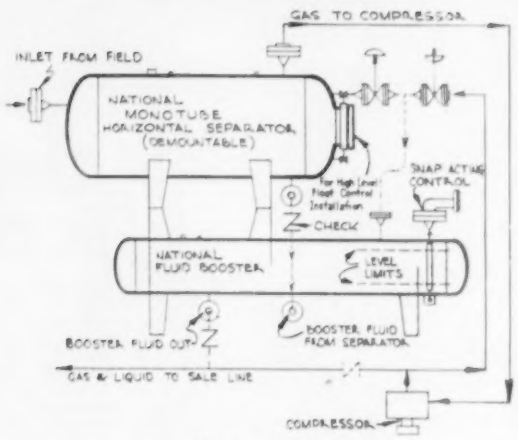


24" 1500 PSI Fluid Booster operating in conjunction with a vertical Oil and Gas Separator and Gas Compressor.



30" 1000 PSI Oil and Gas Separator with 10" Water Leg and 24" 1500 PSI BOOSTER. Fluid is boosted from 800 PSI line into 1350 PSI line.

(Patented and Patents Pending)



FLOW DIAGRAM

APPLICATION

Usual application is in producing areas where well head pressures have fallen to a less pressure than the existing gas sale line pressure. Here the unit is used in conjunction with a gas compressor.

Typical of this situation is the Carthage Field in East Texas which is supplying gas to a 1050 PSI transmission and gathering line whereas the field producing pressures have fallen to 400-600 PSI.

OPERATION

The fully automatic unit operates as follows: The well product enters the separator where gas is separated and scrubbed of any entrained liquid. The liquid flows to the booster and gas flows to a compressor. When fluid level builds up in the booster to a prescribed level, a snap action control opens and closes simultaneously the two valves in the line from the discharge side of the compressor. No gas is vented when double valving is used. Pressure equalizes on the booster with that of the compressor outlet. The liquid then flows from the booster and is commingled with the gas downstream of the compressor and flows then into the sale line.

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TULSA, OKLAHOMA

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DOWELL treatment fractures and acidizes in one operation for extra production boost

In a Stratafrac® treatment, advance-design Dowell equipment is used to pump acid-kerosene material into the pay zone to fracture and acidize in a single operation. Hydraulic pressure, suspended sand and acid all combine in an extra-powerful Dowell treatment designed to enlarge the well's drainage area . . . to increase permeability . . . to boost oil or gas production for you.

Yet down-time is short with Stratafrac. Liquid materials arrive at the well already mixed. Treatment is fast with minimum shut-in afterwards, and no gel breaker needed.

Stratafrac's unusual flexibility makes it effective in almost all types of formations. To match well conditions, Dowell engineers can vary acid and sand content, or add silicate control and clay dissolving agents. This double-action Dowell treatment has brought outstanding, *sustained* production increases to wells in almost every area.

For service, or for more information, call any of the 165 Dowell offices in the United States and Canada; in Venezuela, contact United Oilwell Service. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Department K-11.

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